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IN THE

Supreme Court of the United States

OCTOBER TERM, 1998

EMI GROUP NORTH AMERICA, INC.,
Petitioner,

v.

INTEL CORPORATION,
Respondent.

On Petition for a Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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PETITION FOR A WRIT OF CERTIORARI

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March 1, 1999

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QUESTIONS PRESENTED

1. Whether a court may invoke prosecution history estoppel to bar a patentee from asserting infringement under the doctrine of equivalents, if the patentee did not expressly and unequivocally relinquish the assertedly equivalent subject matter in order to obtain the patent?
2. Where competing inferences concerning estoppel can be drawn from the prosecution history, is the choice between them for the court or the jury to resolve?

LIST OF PARTIES AND RULE 29.6 STATEMENT

The caption lists all of the parties that participated in the proceedings below. Petitioner EMI Group North America, Inc. is the successor in name to Thorn EMI North America, Inc., which originally filed this suit. Petitioner has a parent company, EMI Group plc, which owns 100% of the issued preferred stock of petitioner, and a parent company, Capitol Records, Inc., which owns 100% of the issued common stock of petitioner, but no other parent companies or non-wholly owned subsidiaries.

TABLE OF CONTENTS

	Page
QUESTIONS PRESENTED	i
LIST OF PARTIES AND RULE 29.6 STATEMENT	ii
TABLE OF AUTHORITIES	iv
OPINIONS BELOW	1
JURISDICTION	1
CONSTITUTIONAL PROVISION INVOLVED	2
STATEMENT	2
REASONS FOR GRANTING THE PETITION	11
CONCLUSION	25

TABLE OF AUTHORITIES

CASES — Page

Athletic Alternatives, Inc. v. *Prince Mfg., Inc.*, 73 F.3d 1573 (Fed. Cir. 1996) 14
Cybor Corp. v. *FAS Techs., Inc.*, 138 F.3d 1448 (Fed. Cir. 1998) 14, 20, 22
Dennison Mfg. Co. v. *Panduit Corp.*, 475 U.S. 809 (1985) 23
Desper Products, Inc. v. *QSound Lab., Inc.*, 157 F.3d 1325 (Fed. Cir. 1998) 13
EMI Group North America, Inc. v. *Intel Corp.*, 157 F.3d 887 (Fed. Cir. 1998) 1
Festo Corp. v. *Shoketsu Kinzoku Kogyoj Kabushiki Co.*, 72 F.3d 857 (Fed. Cir. 1995), *vacated and remanded*, 520 U.S. 1111 (1997) 23
Graver Tank & Mfg. Co. v. *Linde Air Products Co.*, 339 U.S. 605 (1950) 11, 22
Hebert v. *Lisle Corp.*, 99 F.3d 1109 (Fed. Cir. 1996) 22
Hormone Research Found., Inc. v. *Genentech, Inc.*, 904 F.2d 1558 (Fed. Cir. 1990) 22
Hubbell v. *United States*, 179 U.S. 77 (1900) 19
Hughes Aircraft Co. v. *United States*, 717 F.2d 1351 (Fed. Cir. 1983) 3, 15
Hughes Aircraft Co. v. *United States*, 148 F.3d 1384 (Fed. Cir. 1998), *petition for certiorari denied*, No. 98-871 (March 1, 1999) 17
ITS Rubber Co. v. *Essex Rubber Co.*, 272 U.S. 429 (1926) 19
Insituform Techs., Inc. v. *Cat Contracting, Inc.*, 99 F.3d 1098 (Fed. Cir. 1996), *aff'd in relevant part*, 161 F.3d 688 (Fed. Cir. 1998) 14
Insituform Techs., Inc. v. *Cat Contracting, Inc.*, 161 F.3d 688 (Fed. Cir. 1998) 14
Kinzenbaw v. *Deere & Co.*, 741 F.2d 383 (Fed. Cir. 1984) 15
Litton Sys. Inc. v. *Honeywell, Inc.*, 140 F.3d 1449 (Fed. Cir. 1998) 19, 20
Litton Sys. Inc. v. *Honeywell, Inc.*, 145 F.3d 1427 (Fed. Cir. 1998) 2, 3, 13, 18

TABLE OF AUTHORITIES—Continued

	Page
Loctite Corp. v. *Ultraseal Ltd.*, 781 F.2d 861 (Fed. Cir. 1985), *overruled on other grounds by Nobelpharma AB* v. *Implant Innovations, Inc.*, 141 F.3d 1059 (Fed. Cir. 1998)	23
Mannesman Demag Corp. v. *Engineered Metal Products Co.*, 793 F.2d 1279 (Fed. Cir. 1986)	13
Markman v. *Westview Instruments, Inc.*, 517 U.S. 370 (1996)	23
Prodyne Enterprises, Inc. v. *Julie Pomerantz, Inc.*, 743 F.2d 1581 (Fed. Cir. 1984)	16
Read Corp. v. *Portec, Inc.*, 970 F.2d 816 (Fed. Cir. 1992)	15
Shepard v. *Carrigan*, 116 U.S. 593 (1886)	12, 13, 19
Smith v. *Magic City Kennel Club Inc.*, 282 U.S. 784 (1931)	19
Sun Studs, Inc. v. *ATA Equip. Leasing, Inc.*, 872 F.2d 978 (Fed. Cir. 1989), *overruled on other grounds by A.C. Aukerman Co.* v. *R.L. Chaides Const. Co.*, 960 F.2d 1020 (Fed. Cir. 1992)	23, 25
Thorn EMI North America, Inc. v. *Intel Corp.*, 928 F. Supp. 449 (D. Del. 1996)	1
Thorn EMI North America, Inc. v. *Intel Corp.*, 936 F. Supp. 1186 (D. Del. 1996)	1
Wang Lab., Inc. v. *Toshiba Corp.*, 993 F.2d 858 (Fed. Cir. 1993)	15, 16
Warner-Jenkinson Co. v. *Hilton Davis Chem. Co.*, 520 U.S. 17 (1997)	*passim*
CONSTITUTION	
U.S. Const. amend. VII	2
OTHER AUTHORITIES	
5A Donald S. Chisum, *Chisum on Patents* (1998)	16, 17, 20
Note, *To Bar Or Not To Bar: Prosecution History Estoppel After Warner-Jenkinson*, 111 Harv. L. Rev. 2330 (1998)	16

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OPINIONS BELOW

The decision of the court of appeals is reported at 157 F.3d 887 (Fed. Cir. 1998). See Pet. App. 1a. The order of the court of appeals denying rehearing and rehearing in banc is not reported. See Pet. App. 93a. The initial decision of the district court on the issues presented here is reported at 936 F. Supp. 1186 (D. Del. 1996). See Pet. App. 58a. The decision of the district court on reconsideration of that initial decision is not reported, and is reproduced at Pet. App. 87a. An earlier decision of the district court referenced by the foregoing opinions is reported at 928 F. Supp. 449 (D. Del. 1996). See Pet. App. 23a.

JURISDICTION

The judgment of the court of appeals was entered on September 29, 1998. A petition for rehearing and sug-

gestion for rehearing in banc was denied on December 1, 1998. The jurisdiction of this Court is invoked under 28 U.S.C. § 1254(1).

CONSTITUTIONAL PROVISION INVOLVED

The Seventh Amendment to the Constitution of the United States provides:

> In Suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury, shall be otherwise reexamined in any Court of the United States, than according to the rules of the common law.

STATEMENT

Under the doctrine of equivalents, a product or process that does not literally infringe every element of a patent claim may nevertheless be found to infringe the patent if it contains features that are equivalent to the literal terms of the patent claim. The doctrine of equivalents thus "permeates the entire fabric of patent law, and appears in virtually every case involving patent enforcement." *Litton Sys. Inc.* v. *Honeywell, Inc.*, 145 F.3d 1472, 1472 (Fed. Cir. 1993) (Plager, J., dissenting from denial of rehearing in banc). In *Warner-Jenkinson Co.* v. *Hilton Davis Chemical Co.*, 520 U.S. 17, 28-30, 40 (1997), this Court affirmed the vitality of this important doctrine, but left its scope significantly undefined. Accordingly, there is "perhaps no question more important to the health of patents than the scope and application of the judicially-created doctrine of equivalents." *Litton Sys.*, 145 F.3d at 1472 (Plager, J., dissenting).

The uncertainty over the application of the doctrine of equivalents is greatest with respect to the principal doctrinal restriction on its scope—the doctrine of prosecution history estoppel. That doctrine bars a patentee from asserting as an equivalent any subject matter that the patentee surrendered in order to obtain the patent. It is

premised on the notion that, in choosing to acquiesce in, rather than directly appeal, the Patent Office's demand that the applicant narrow its claims to avoid the prior art, the applicant failed to exhaust administrative remedies and thus waived any right in subsequent litigation to recapture the surrendered ground. Like the doctrine of equivalents which it modifies, prosecution history estoppel is ubiquitous in patent cases, because "[a]mendment of claims is a common practice in prosecution of patent applications" and "comparatively few claims [are] allowed exactly as originally filed and never amended." *Hughes Aircraft Co.* v. *United States*, 717 F.2d 1351, 1363 (Fed. Cir. 1983).

Despite the central importance of prosecution history estoppel, the Federal Circuit's leading cases that purport to set forth the criteria for its application have been aptly described as "irreconcilable." In some cases, the Federal Circuit requires an "unequivocal statement" surrendering the subject matter at issue; in others, the Federal Circuit infers such a surrender from the fact of amendment in a field crowded with prior art. *Warner-Jenkinson* did not resolve this conflict; if anything, it increased the uncertainty concerning the scope of prosecution history estoppel. See, *e.g.*, *Litton Sys.*, 145 F.3d at 1472-78 (separate opinions of Plager, Clevenger, and Gajarsa, JJ., dissenting from denial of rehearing in banc). This case, which involves a patent on competitively significant technology, and in which the Federal Circuit inferred estoppel from the factual record "as a whole" rather than applying its "unequivocal statement" test, well-illustrates the need for a definitive standard in this important and recurring area of patent law.

1. This case arises out of a patent infringement dispute regarding methods used by Intel to manufacture the transistors contained in its computer processors. With an Intel processor inside nearly every personal computer used today, the Federal Trade Commission has alleged that "Intel has monopoly power in the market for general-purpose microprocessors." Complaint, *In the Matter of Intel Corp.*, Docket No. 9288, ¶ 6 (F.T.C. 1998). Intel's success is due, in significant part, to its ability to offer the public increasingly faster processors which, in turn, require faster transistors.

Transistors are the building blocks of any processor. They function like switches: When current runs through them they are "on"; when it does not, they are "off." Pet. App. 2a. The on/off status of each of the millions of individual transistors in a processor corresponds to the binary 1/0 sequences of information that the computer uses to perform its functions.

A transistor is made on a wafer (or substrate) of silicon on which is set an electrode, referred to as a gate. See Figure 1A. To turn the transistor on, voltage is applied to the gate. See Figure 1B. Current then flows from the source region, on one side of the gate, through a channel under the gate, to the drain region at the other side of the gate. See *id.*; Pet. App. 2a-3a.

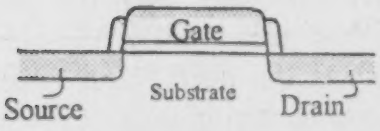

Figure 1A

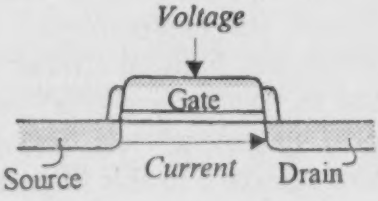

Figure 1B

Pure silicon does not conduct electricity well. To create the electrically conductive "source" and "drain" regions, therefore, it is necessary first to bombard the silicon substrate with ions, thereby forming ion-implanted regions on either side of the gate, while preserving an ion-free channel under the gate. Pet. App. 3a. It is then necessary to heat the implanted regions to activate the ions and make the implanted regions capable of conducting electricity. *Id.*

Heating the silicon also serves, however, to diffuse the ions throughout the substrate. This can cause the source and drain regions to extend past the edges of the gate and into the channel region underneath the gate. See Figure 2. Such diffusion contributes to the build-up of electrical charge, called "Miller capacitance," that slows down the speed of the transistor. Pet. App. 3a.

Figure 2

EMI is the owner of U.S. Patent No. 4,486,943 ("the '943 Patent"), which describes an invention for building transistors with source and drain regions that are properly aligned with the edges of the gate (as in Figures 1A and 1B). This alignment reduces Miller capacitance and can produce a faster transistor. Pet. App. 4a.

The method set forth in the '943 Patent involves protecting the substrate immediately adjacent to the gate from ion implantation. According to the method of claim 1 of the '943 Patent, a protective layer of oxide is thermally grown on the top and sides of the gate electrode that is relatively thicker than the oxide grown over the rest of the substrate (*i.e., differentially* thermally grown). See Figure 3A. This oxide layer is then selectively etched away, leaving oxide on the sides of the gate. See Figure 3B. This remaining oxide serves as a shield against ion implantation into the substrate adjacent to the gate (Figure 3C), which results, after heating, in properly aligned source and drain regions (Figure 3D). See Pet. App. 4a-5a.

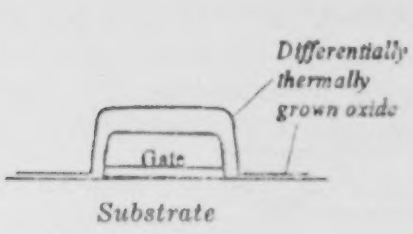

Figure 3A

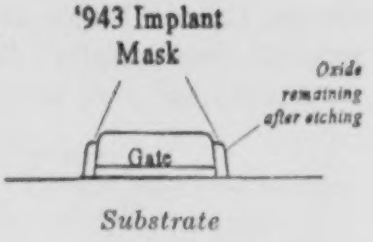

Figure 3B

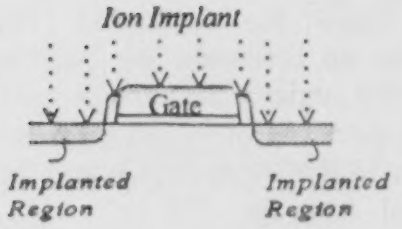

Figure 3C

Figure 3D

Intel's accused processes for fabricating transistors employ a method for manufacturing properly aligned transistors. As in EMI's method, Intel's method employs a protective layer of oxide that is etched to ensure that the ion-implantation and heat-driving steps will result in properly aligned source/drain regions. As in EMI's method, Intel's method also begins by differentially thermally growing a protective layer of oxide. In addition, however, Intel deposits a layer of nitride over the thermally grown oxide that is then etched before ion implantation. See Figure 4.[1]

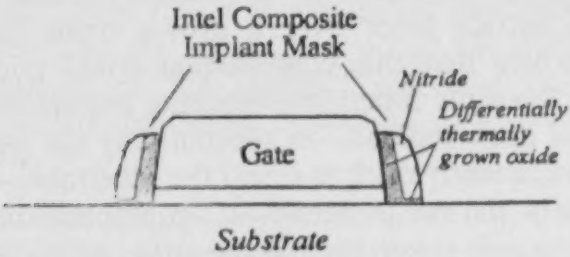

Figure 4

2. EMI brought suit against Intel in the United States District Court for the District of Delaware. EMI alleged that several Intel processes literally infringed the '943 patent and, alternatively, that these processes infringed under the doctrine of equivalents. The District Court initially granted Intel's motion for partial summary judgment on three of its processes, none of which is at issue here. Pet. App. 23a-57a.

After a *Markman* hearing, the district court then addressed Intel's motion for summary judgment on the three other procseses that are at issue here. Pet. App.

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[1] Figures 1-3 above are based on figures from the '943 patent; Figure 4 is based on the lower courts' descriptions of Intel's accused processes, *see* Pet. App. 17a-18a, 84a, and does not depict the actual scale, dimensions, or final structure of Intel's transistors. These figures are included here to illustrate, for the Court's convenience, the relevant technical points discussed in the opinions below and in this statement.

58a-86a. The court granted summary judgment for Intel as to literal infringement. *Id.* at 82a-83a. The court explained that Intel's accused processes fell outside the literal language of claim 1 because they do not use "a grown oxide alone" to "serve as an implant mask," but instead rely on a composite of grown oxide and deposited nitride. *Id.* at 83a.

The district court denied Intel's motion for summary judgment, however, under the doctrine of equivalents. The court noted that "all of Intel's accused processes deposit a nitride layer over a grown oxide layer," and that it "seems that this combination could perform substantially the same function—blocking implantation of the source and drain regions—in substantially the same way—by being sufficiently thick to shield the substrate—to achieve substantially the same result—a 'gap' between the side edges of the gate electrode and the edges of the source and drain regions." Pet. App. 84a.

The district court then stated that Intel did not "appear to dispute" equivalency, but argued instead that "prosecution history estops" EMI from asserting that its patent covers processes that deposit a nitride layer over a layer of thermally grown oxide. Pet. App. 84a. The court rejected Intel's estoppel claim for several reasons. First, although claim 1, as initially filed, referred not to "differential[ly] thermal[ly] grow[ing]" but more broadly to " 'forming' " an implant mask, the "patent examiner rejected this claim for reasons unrelated to the method of forming the mask." *Id.* at 85a. Second, the examiner's response to the initial amendment of claims 1 and 6 indicated again that the method of forming the implant mask (*i.e.*, whether by growth or by deposition) was immaterial to patentability. In light of prior art that taught "differential oxide growth," claim 1 was amended to require "differential thermal growth" of an implant mask but claim 6 was initially amended, more broadly, to require only the "establishing" of an implant mask. Despite the broad

language of claim 6, "[t]he examiner eventually indicated that both claim 1 and claim 6 would be acceptable with the addition of an anisotrophic etching step," thereby making plain that the etching step, and not the method of establishing the mask, was important to patentability. *Id.* Finally, the district court noted that while the applicant subsequently and voluntarily amended claim 6 to require differential thermal oxide growth, that later change, and the statements made to explain it, did not establish a "clear" basis for estoppel. *Id.* at 86a. In particular, the court found it significant that the applicant "never indicated that deposition would not suffice to meet the limitations of the claims," and that the examiner "never rejected the use of deposition to form the implant mask." *Id.*

Intel moved for reconsideration, raising a new theory that prosecution history estoppel arose from the cancellation of pending claims 8 and 23, which Intel alleged were directed towards composite implant masks. According to this theory, the patentee gave up all claim to any kind of composite implant mask by canceling these claims.

EMI opposed this new argument because claims 8 and 23 covered only certain kinds of implant masks, and would not have encompassed the particular composite implant mask used by Intel. EMI therefore argued that, while the patentee may have relinquished some subject matter by canceling these claims, it did not relinquish coverage of Intel's composite mask.

Reversing its prior finding of no prosecution history estoppel, the district court adopted Intel's new theory. Pet. App. 87a-92a. The court did not disavow any of its previous factual findings with respect to estoppel. Rather, the court based its reversal on the patentee's cancellation of claims 8 and 23 after a rejection over four prior patents. The court explained that the applicant's "canceling claims 8 and 23 in the context of his arguments as to how the invention could be distinguished over the prior art suggests

he felt compelled to abandon claims to a composite implant mask." *Id.* at 92a. The only such "argument" cited by the court was one in which the applicant provided three reasons for distinguishing his claims over the prior art. *Id.* at 91a. Although one of these reasons was " 'the use of differential thermal growth with a high differential rate,' " the other two focused on the use of " 'anisotrophic etching' " to distinguish the prior art. *Id.* Furthermore, nowhere did the applicant, in this explanation or elsewhere, even mention a variation of the claimed process that would deposit a supplemental layer on top of a differentially thermally grown oxide layer to achieve the desired masking effect, let alone relinquish any intent to claim such a variation as equivalent. *Id.*; see *id.* at 86a.

3. The Federal Circuit affirmed the district court's rulings as to claim construction and literal infringement. The Federal Circuit also "agree[d] with EMI" that "there is no substantial difference between the masking effect" achieved by the '943 process and the effect achieved by Intel's accused process. Pet. App. 18a. The court of appeals nevertheless affirmed the entry of summary judgment on the doctrine of equivalents, albeit for reasons different than those offered by the district court.

The Federal Circuit "agree[d] with EMI that the cancellation of its broad claims [8 and 23] to composite masks was not a disclaimer of every possible composite mask." Pet. App. 20a. Similarly, as to the prior art references that prompted the cancellation and amendment of these claims, the court of appeals agreed that "none of these references explicitly refers to composite dielectric layers as implant masks over a gate." *Id.* at 19a. And the Federal Circuit did not contradict the district court's earlier findings (see *id.* at 86a) that specifying the method of establishing the implant mask—whether by growing or by depositing oxide—had never been viewed by the examiner as material to patentability, and that the applicant had never said that deposition could not be used.

Nevertheless, the court of appeals "determined that the district court correctly interpreted the prosecution history as a whole in estopping EMI." Pet. App. 20a. The court found it significant that "[t]he applicant had stressed to the examiner throughout the prosecution that the differential thermal growth of the masking oxide . . . provided a patentable distinction from" the relevant prior art references. *Id.* at 20a-21a. The court repeated that "EMI had been steadfast in its argument that a patentable distinction from the prior art was the differentially thermally grown oxide mask" that was to be used as an implant mask. *Id.* at 21a. In support of these conclusions, however, the court referred only to the same statement of reasons for claim amendments cited by the district court, and on the applicant's acknowledgment that there " 'must be a huge number of patents which relate to the formation of a transistor vice.' " *Id.* at 19a-20a, 21a.

REASONS FOR GRANTING THE PETITION

In *Graver Tank & Mfg. Co.* v. *Linde Air Products Co.*, 339 U.S. 605, 607 (1950), this Court affirmed the vitality of the doctrine of equivalents, finding it essential to avoid "convert[ing] the protection of the patent grant into a hollow and useless thing." In *Warner-Jenkinson*, this Court unanimously reaffirmed that holding, observing that "the lengthy history of the doctrine of equivalents strongly supports adherence to our refusal in *Graver Tank* to find that the Patent Act conflicts with that doctrine," and consigning policy arguments concerning the merits of the doctrine to Congress. 520 U.S. at 28.

The Court also rejected petitioner's argument in *Warner-Jenkinson* "that the reason for an amendment during patent prosecution is irrelevant to any subsequent estoppel." 520 U.S. at 30. The Court explained that in each of its prior cases cited by petitioner, "prosecution history estoppel was tied to amendments made to avoid the prior art, or otherwise to address a specific concern—such as obviousness—that arguably would have rendered the

claimed subject matter unpatentable." *Id.* at 30-31; see *id.* at 31 & n.5. The Court therefore held that, in determining whether to apply estoppel in a case, like *Warner-Jenkinson,* where the amendment appeared not to have been made to overcome an objection based on the prior art, "[w]hat *is* permissible for a court to explore is the reason (right or wrong) for the objection and the manner in which the amendment addressed and avoided the objection." *Id.* at 33 n.7.

On the crucial issue—how to evaluate the legal significance of the "reason . . . for the objection and the manner in which the amendment addressed and avoided the objection"—the Federal Circuit's jurisprudence is internally inconsistent. In some cases, the Federal Circuit insists upon proof that the applicant expressly and unequivocally surrendered the subject matter at issue. This approach is most consistent with the fundamental reasons that justify the doctrine of prosecution history estoppel. Had it been applied in this case, estoppel could not have served to bar petitioner's meritorious claim under the doctrine of equivalents.

In this and other cases, however, the Federal Circuit has not required proof of such an unequivocal surrender, but instead has purported, as a matter of law, to infer that estoppel is appropriate from the fact that the amendment was prompted by an objection from the Patent Office based on prior art, and from additional facts such as a crowded field of prior art. That approach not only broadens the scope of prosecution history estoppel far beyond what its underlying rationale will support, it usurps the role historically reserved to the jury to determine the proper scope of equivalents.

I.

To understand where the conflict over the scope of prosecution history estoppel arises, it is useful to begin by considering an uncontroversial case of prosecution history estoppel, such as *Shepard* v. *Carrigan,* 116 U.S. 593,

596-97 (1886). There, the Patent Office initially rejected a patent application for a skirt protector with a plain border in view of a prior patent on a skirt protector that also had a plain border. *Id.* The applicant did not appeal the rejection, but amended her claim to require " 'a plaited or fluted border,' " an amendment without which "the patent would not have been issued." *Id.* Accordingly, the Court barred her from asserting that another skirt protector with a plain border was equivalent to her invention. *Id.* Such classic examples of prosecution history estoppel still arise on occasion today. See, *e.g.*, *Desper Products, Inc.* v. *QSound Lab., Inc.*, 157 F.3d 1325, 1338-39 (Fed. Cir. 1998); *Mannesman Demag Corp.* v. *Engineered Metal Products Co.*, 793 F.2d 1279, 1285 (Fed. Cir. 1986).

More typical, however, and more problematic, is "the situation in which a patentee attempts to recapture matter that was not expressly disclaimed by amendment"—a fact pattern that this Court's cases prior to *Warner-Jenkinson* "did not present." *Litton Sys., Inc.* v. *Honeywell, Inc.*, 145 F.3d 1472, 1477 (Fed. Cir. 1998) (Gajarsa, J., dissenting from denial of rehearing in banc). For example, taking the facts of *Shepard*, assume that the borders of the allegedly infringing skirt protectors were not plain, but rather were embossed with a pattern that distinguished them from the plain borders of the prior art and that also placed them outside the literal terms of the patent. Note that the applicant was not required by the examiner to relinquish any claim to embossed borders. The unresolved question is: What additional facts, if any, must be shown to estop the patentee from presenting her claim of equivalents (*i.e.*, that embossed borders are not substantially different from plaited or fluted borders) to a jury?

This basic question recurs in the Federal Circuit repeatedly, year in, year out—albeit with more sophisticated technology. *Warner-Jenkinson* does not answer it. Neither has the Federal Circuit. Its cases reveal mutually inconsistent, irreconcilable positions. These conflicting

positions are outcome-determinative, have persisted for years, and should be replaced by a single, clear standard, which only this Court can supply.

1. In some cases, the Federal Circuit has held that there can be no estoppel unless the defendant can identify in the prosecution history an unequivocal, express statement by the patentee that it was relinquishing the equivalent subject matter. The leading case taking this view, reaffirmed on this very point in light of *Warner-Jenkinson* just months ago, is *Insituform Technologies, Inc.* v. *Cat Contracting, Inc.*, 99 F.3d 1098, 1108-09 (Fed. Cir. 1996), *aff'd in relevant part*, 161 F.3d 688, 691-92 (Fed. Cir. 1998). The patent at issue in *Insituform*, for creating a vacuum using a single vacuum cup, had been amended during prosecution to overcome an objection based on prior art that also used a single vacuum cup. *Id.* The allegedly equivalent process, however, used *multiple* cups to create the vacuum. *Id.* The Federal Circuit refused to find an estoppel because the prior art "disclose[d] nothing" about the defendant's allegedly equivalent multiple-cup vacuum process, and because the applicant's statements were " 'too equivocal' " to be read as relinquishing such a claim. *Insituform*, 161 F.3d at 691-92. In this line of cases, then, the Federal Circuit has insisted upon proof of an unequivocal surrender of the equivalent subject matter. See, *e.g.*, *Cybor Corp.* v. *FAS Techs., Inc.*, 138 F.3d 1448, 1458, 1460 (Fed. Cir. 1998) (in banc) ("While it is quite clear the inventors limited the scope of their claims to overcome" a prior patent involving an external reservoir, there was no basis for estoppel because the "inventor's statements to the PTO . . . do not show the deliberate, unequivocal surrender of all external reservoirs"); *Athletic Alternatives, Inc.* v. *Prince Mfg., Inc.*, 73 F.3d 1573, 1582 (Fed. Cir. 1996) ("it is difficult to conclude, in light of the truly equivocal nature of the claim phrase 'varies between' and the conflicting evidence in the prosecution history, that AAI surrendered protection . . . with the clarity that

prosecution history estoppel requires"); *Read Corp.* v. *Portec, Inc.*, 970 F.2d 816, 824-25 (Fed. Cir. 1992) (refusing to find estoppel where applicant pointed to a "wealth of differences" between the amended claim and the prior art and thus did not clearly surrender claim of equivalents as to one such difference that was not independently "the basis for allowance").[2]

In a second line of cases, however, including this case, the Federal Circuit has refused to analyze whether relinquishing the equivalent subject matter was necessary in order to overcome the examiner's prior art objection, or whether the applicant expressly and unequivocally relinquished that subject matter. The leading cases here are *Wang Laboratories, Inc.* v. *Toshiba Corp.*, 993 F.2d 858 (Fed. Cir. 1993) and *Kinzenbaw* v. *Deere & Co.*, 741 F.2d 383 (Fed. Cir. 1984). In *Kinzenbaw*, the applicant responded to an initial rejection by adding two new claim limitations. One of these new limitations was not only "unnecessary to distinguish the prior art," it was actually present in the prior art that was the basis for the rejection. *Id.* at 389. The patentee therefore argued that the addition of this limitation neither could have been the basis for the examiner's allowance of the amended claim nor could reflect a conscious decision to forgo a direct appeal. Nevertheless, the Federal Circuit refused to permit the patentee to invoke the doctrine of equivalents for that limitation because it had been introduced as part of an effort to distinguish prior art, and because such invocation "would be particularly inappropriate here, where we deal with 'improvement patents in a crowded art.'" *Id.*

Similarly, in *Wang*, the accused subject matter, "a substrate having memory chips mounted in two rows," did "not read on the prior art," *Wang*, 993 F.2d at 867, and

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[2] *See also Hughes Aircraft Co.* v. *United States*, 717 F.2d 1351, 1363 (Fed. Cir. 1983) (applicant that narrows a claim in response to an objection based on prior art does not necessarily surrender claim for equivalents as to all subject matter that original claim would have covered).

nowhere did the applicant expressly disavow coverage of a two-row architecture in overcoming the examiner's objections. *Id. at* 867-68. Nevertheless, the court reversed a jury verdict of infringement, holding that the amended claim must be read "to exclude any embodiment in which the memory chips are not physically located in a single row." *Id.* at 868. See also *id.* (also precluding Wang from asserting that "3-pack memory modules" were equivalent to Wang's nine-chip module, because the nine-chip limitation was introduced to distinguish a prior art module with eight chips); *Prodyne Enterprises, Inc.* v. *Julie Pomerantz, Inc.*, 743 F.2d 1581, 1583 (Fed. Cir. 1984) (patentee limited to literal meaning of claim element amended in response to rejection based on prior art, regardless of whether that limitation was necessary to distinguish the prior art).

These two approaches to evaluating prosecution history for purposes of estoppel are mutually exclusive. One commentator, after contrasting the "narrow approach" to prosecution history estoppel as typified by *Insituform* with the "broad approach" illustrated by *Kinzenbaw* and *Wang*, concluded that the "two lines of cases appear to be irreconcilable." Note, *To Bar Or Not To Bar: Prosecution History Estoppel After Warner-Jenkinson*, 111 Harv. L. Rev. 2330, 2336 (1998). Similarly, a leading treatise on patent law recently described at length these "two lines of authority on the scope of an estoppel based on an amendment or argument that distinguished the prior art," one being "strict" and the other being "flexible," 5A Donald S. Chisum, *Chisum on Patents* § 18.05[3][b], at 492 (1998), and observed not only that the two lines themselves are inconsistent, *id.* at 496-503, but that the "flexible approach" is itself so ill-defined that the court reaches different results in cases whose relevant features with respect to estoppel are otherwise identical in all respects. See *id.* at 505-06 (comparing *Sun Studs, Inc.* v. *ATA Leasing, Inc.*, 872 F.2d 978 (Fed. Cir. 1989) (*overruled on other grounds by A.C. Aukerman Co.* v. *R.L.*

Chaides Const. Co., 960 F.2d 1020, 1038-39 (Fed. Cir. 1992)) with *Environmental Instruments, Inc.* v. *Sutron Corp.*, 877 F.2d 1561 (Fed. Cir. 1989)).

The facts of *Warner-Jenkinson* presented this Court with an opportunity to resolve this issue, but the Court chose not to do so. In *Warner-Jenkinson*, the applicant, in response to a Patent Office objection based on a prior art process that operated at a pH in excess of 9.0, limited its claims to processes with a pH of between 6.0 and 9.0. Because the lower limit of a pH of 6.0 was unnecessary to distinguish the prior art, the Federal Circuit (consistent with *Insituform*, but directly contrary to *Wang* and *Kinzenbaw*) found no estoppel. This Court reversed, but in remanding for further exploration of the "reason (right or wrong) for the objection and the manner in which the amendment addressed and avoided the objection," 520 U.S. at 33 n.7, the Court "did not directly address" whether one of the two competing Federal Circuit standards, or some other standard, should be employed to evaluate the newly developed record. See 5A *Chisum on Patents* § 18.05[3][c], at 508-09.

Indeed, if anything, the Court's opinion in *Warner-Jenkinson* generated further uncertainty as to the appropriate standard. Three Federal Circuit Judges and the United States read that opinion to set forth a new rule—radical in its departure from precedent and in its constricting effect on the doctrine of equivalents—that once a limitation is added for any reason related to "patentability," prosecution history estoppel acts as a per se bar to any assertion of equivalents with respect to that element, regardless of the "reason" for the examiner's objection and "the manner in which the amendment addressed" it. *Warner-Jenkinson*, 520 U.S. at 30 n.7; see, *e.g.*, *Hughes Aircraft Co.* v. *United States*, 148 F.3d 1384, 1385-86 (Clevenger, J., joined by Gajarsa, J., dissenting from denial of rehearing in banc) (Fed. Cir. 1998), *petition for certiorari denied*, No. 98-871 (March 1, 1999); *Litton*

Sys., 145 F.3d at 1472-78 (separate opinions of Plager, Clevenger, and Gajarsa, JJ., dissenting from denial of rehearing in banc). Although that reading has been rejected by a majority of the Federal Circuit and appears to conflict with other aspects of the Court's opinion, the starkly drawn and passionately expressed views of the dissenters and the United States concerning the meaning of *Warner-Jenkinson* as to the scope of prosecution history estoppel further underscores the need for additional guidance from this Court.[3]

2. This case well-illustrates the need for a single, clear rule on the scope of prosecution history estoppel. It involves, first of all, a classic instance of equivalence. Both the district court and the court of appeals "agree[d] with EMI" that "there is no substantial difference" between EMI's patented process for fabricating transistors and Intel's accused processes. Pet. App. 18a, 84a. There simply is no meaningful difference "between the masking effect of differentially thermally grown oxide of a certain thickness, and the masking effect of differentially thermally grown oxide of a lesser thickness that is supplemented by deposited oxide [sic, nitride] to achieve the needed thickness." Pet. App. 18a; compare, for example, Figure 3B with Figure 4, *supra*, pages 6, 7. Thus, only the invocation of prosecution history estoppel stands between EMI and a judgment of infringement under the doctrine of equivalents.

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[3] While the Court's denial of certiorari in *Hughes* effectively affirms, properly in petitioner's view, the Federal Circuit's rejection of the United States' overly narrow reading of *Warner-Jenkinson*, that denial does not resolve the longstanding division of authority at issue in this case. Given the recurring nature of this issue, and its fundamental importance to patent law, that division should now be resolved by this Court.

Yet prosecution history estoppel, properly defined, should play no role in this case. None of the four prior art patents cited by the examiner and the lower courts involved implant masks composed of a differentially thermally grown oxide layer supplemented by a deposited nitride layer; the applicant never referred to such a composite mask during prosecution; and "the examiner never rejected the use of deposition to form the implant mask." Pet. App. 86a. Given these facts, under cases like *Insituform*, which require an "unequivocal surrender" of the intent to cover composite masks, there is no basis for finding that EMI voluntarily surrendered its equivalents claim in prosecuting its patent. EMI made no such surrender. That is why the lower courts were compelled to make inferences from the "prosecution history as a whole" and the "congested [prior] art" to explain their judgment. See *id.* at 20a-21a.

3. This issue also merits review by this Court because the requirement of an express and unequivocal surrender is the better rule. It comports fully with the exhaustion rationale for prosecution history estoppel that this Court historically has recognized. The deliberate surrender of particular subject matter in response to an examiner's rejections reflects a knowing and considered choice by the applicant to forgo a direct appeal of the Patent Office's rejection of the broader claim. See *Smith* v. *Magic City Kennel Club Inc.*, 282 U.S. 784, 789 (1931) ("If dissatisfied with the rejection he should pursue his remedy by appeal; and where, in order to get his patent, he accepts one with a narrower claim, he is bound by it."); *ITS Rubber Co.* v. *Essex Rubber Co.*, 272 U.S. 429, 443 (1926); *Shepard*, 116 U.S. at 597; *Hubbell* v. *United States*, 179 U.S. 77, 83 (1900); *Litton Sys. Inc.* v. *Honeywell, Inc.*, 140 F.3d 1449, 1465 (Fed. Cir. 1998) ("prosecution history estoppel is based" on the principle

that "[a]n applicant cannot surrender that which he does not know"); see 5A *Chisum on Patents* § 18.05[1][c], at 422 ("Perhaps the most satisfying rationale for file wrapper (prosecution history) estoppel is that of exhaustion of administrative remedies"). Where the equivalent subject matter is not in the prior art, and the prosecution history reflects no unequivocal, voluntary choice to relinquish that subject matter, then there was no basis for an administrative appeal to begin with, no deliberate decision not to take such an appeal, and thus no reason to invoke estoppel.

The unequivocal surrender rule also fully comports with the need for greater certainty in the application of prosecution history estoppel. Although the Federal Circuit routinely states that prosecution history is to be evaluated by considering "whether a competitor would reasonably believe that the applicant had surrendered the relevant subject matter," *Cybor Corp.*, 138 F.3d at 1457, that definition is plainly circular: In the absence of a single, clear standard, there is no way for either the applicant or the reasonable competitor to know when a particular subject matter is being surrendered. How, for example, could any applicant or competitor confidently predict whether the Federal Circuit will choose to draw inferences from the "prosecution history as a whole" and what those inferences will be? Only a rule that limits estoppel, in cases where the equivalent subject matter lies outside the prior art on which a rejection is based, to statements that evince a "clear and unmistakable surrender" of the equivalent subject matter (*Litton Systems*, 140 F.3d at 1458), will operate in practice to give all interested parties notice as to the scope of prosecution history estoppel in any particular case.

II.

Were the Court nevertheless to reject a rule that restricted prosecution history estoppel to an express and unequivocal relinquishment of the subject matter, and endorse a more open-ended inquiry of the type pursued

below, a second important question would then arise. Is it for the court or for the jury to resolve any dispute about the proper inference to draw from "the prosecution history as a whole" and any disputed facts and conflicting expert testimony that bear on its interpretation? This is an issue of fundamental importance that was not resolved in *Warner-Jenkinson,* and one on which the Federal Circuit's opinions, once again, are inconsistent.

1. *Warner-Jenkinson* neither confronted nor resolved this question. Although the Court stated that "the various legal limitations on the application of the doctrine of equivalents are to be determined by the court," 520 U.S. at 39 n.8, the Court also "place[d] the burden on the patent holder to establish the reason for an amendment required during patent prosecution" in order to rebut the "presum[ption]" that such amendments pertain to "patentability." *Id.* at 33. This latter aspect of the Court's holding suggests that the issue of prosecution history estoppel may at bottom be factual or, at the very least, may turn on questions of fact. See also *id.* at 41-42 (Ginsburg, J., concurring, joined by Kennedy, J.) (observing that the Court's opinion "is sensitive to" the difficulty, "[y]ears after the fact," of "establish[ing] an evidentiary basis that would overcome the new presumption," and noting that it was open to the patentholder on remand to attempt to prove that reasons for the amendment "can now be established").

Furthermore, although the Court reserved judgment on the Federal Circuit's longstanding position that "the application of the doctrine of equivalents" is "for the jury to decide," *Warner-Jenkinson,* 520 U.S. at 38, it did note that there is "ample support in our prior cases for that holding." *Id.* If the doctrine of equivalents is properly a jury question, it is for the jury, not the court, to draw inferences from the "crowded" field of prior art and from equivocal statements in the prosecution history in order to determine whether the accused subject matter truly is equivalent. As this Court observed in *Graver Tank,*

"[w]hat constitutes equivalency must be determined against the context of the patent, *the prior art*, and the particular circumstances of the case." 339 U.S. at 609 (emphasis added). Thus, when, as here, the defendant alleges that the patent was obtained in a crowded field of prior art, that fact should not compel estoppel but rather should be considered by the fact-finder in determining the range of equivalents to be afforded the limitation in question. Indeed, it is precisely to permit the factfinder to make such judgments that the Court in *Graver Tank* stressed that consideration of the prior art was an essential part of the equivalents inquiry. See *id.* ("Proof [of equivalents] can be made in any form: through testimony of experts or others versed in the technology, by documents, including texts and treatises; and, of course, by the disclosures of the prior art."). Affording prosecution history estoppel an expansive scope thus takes from the jury an issue that the jury traditionally has resolved.

2. The Federal Circuit's decisions reveal a fundamental confusion concerning the extent to which prosecution history estoppel is to be understood as a question of law. On the one hand, the Federal Circuit regularly states that "[p]rosecution history estoppel is a legal question subject to *de novo* review on appeal." *Cybor Corp.* v. *FAS Techs., Inc.*, 138 F.3d 1448, 1460 (Fed. Cir. 1998) (in banc). On the other hand, acknowledging that prosecution history estoppel turns on issues of fact such as what subject matter was surrendered and why, the Federal Circuit has repeatedly remanded disputes about the applicability of prosecution history estoppel for trial. See, *e.g.*, *Hebert* v. *Lisle Corp.*, 99 F.3d 1109, 1118 (Fed. Cir. 1996) (refusing to resolve prosecution history estoppel issues because "these questions are not free of underlying factual determinations"); *Hormone Research Found., Inc.* v. *Genentech, Inc.*, 904 F.2d 1558, 1567 (Fed. Cir. 1990) ("disputed factual questions regarding the intent and meaning of the [applicant's] prosecution arguments precludes summary judgment"); *Loctite Corp. v. Ultra-*

seal Ltd., 781 F.2d 861, 871-72 (Fed. Cir. 1985) *overruled on other grounds by Nobelpharma AB* v. *Implant Innovations, Inc.*, 141 F.3d 1059, 1067-68 (Fed. Cir. 1998) ("the district court may, on remand, want to take additional evidence (if it wishes) and make additional findings underlying the question of prosecution history estoppel"). The Federal Circuit has further confirmed that it is not "reversible error" to submit the question of prosecution history estoppel to the jury, *Festo Corp.* v. *Shoketsu Kinzoku Kogyoj Kabushiki Co.*, 72 F.3d 857, 863-64 Fed. Cir. 1995), *vacated and remanded*, 520 U.S. 1111 (1997), and has even reversed a district court's entry of judgment as a matter of law on prosecution history estoppel on the ground that "there was substantial evidence whereby a reasonable jury could have found no estoppel arising from the prosecution history." *Sun Studs, Inc.*, 872 F.2d at 987.

This Court has repeatedly recognized that the extent to which a recurring issue of patent law is a question of law or fact is a matter of fundamental importance. In *Markman* v. *Westview Instruments, Inc.*, this Court granted review to resolve whether "the construction of a patent, including terms of art within its claim, is exclusively within the province of the court." 517 U.S. 370, 372 (1996). In *Warner-Jenkinson*, the Court expressly left open the question "whether, or how much of, the application of the doctrine of equivalents can be resolved by the court." 520 U.S. at 38. And in *Dennison Mfg. Co.* v. *Panduit Corp.*, 475 U.S. 809 (1985), the Court summarily reversed and remanded the judgment of the Federal Circuit because of the lack "of the Federal Circuit's informed opinion on the complex issue of the degree to which the obviousness determination is one of fact." *Id.* at 811.

If prosecution history estoppel properly may be applied only to block the patentee from recapturing subject matter that was expressly and unequivocally surrendered in order to obtain the patent, then its application—like summary judgment—is for the court. If, however, prosecution his-

tory estoppel may be premised, as it was here, on the "conflicting views" of the expert witnesses," the "congested" nature of prior art, and ambiguous or conflicting statements in the "prosecution history as a whole" (Pet. App. 8a, 20a, 21a), then a jury should weigh that conflicting evidence.

This case aptly illustrates the unfairness of the Federal Circuit's inconsistency on when to have the factfinder resolve the scope of estoppel and equivalents. In the absence of any clear, unequivocal statement relinquishing coverage of all composite implant masks, the court of appeals inferred estoppel from the "congested art," "all of the cited references," and the "prosecution history." Pet. App. 21a. This analysis expressly was not, and could not reasonably have been, premised solely upon a cold reading of the public record in the Patent Office. As the court candidly admitted, "our determination of these issues on appeal has drawn on the record of the *Markman* hearing and the testimony of the expert witnesses, including their conflicting views of the significance of various distinctions drawn during patent prosecution with respect to the prior art." *Id.* at 8a. And even apart from the court's resolution of conflicting expert testimony, the key factual predicates supporting the district court's initial rejection of Intel's estoppel claim alone should have precluded summary disposition of the estoppel issue by the court of appeals. The district court found that:

(1) the examiner "never rejected the use of deposition to form the implant mask";

(2) the examiner "appeared to accept deposition as an acceptable method"; and

(3) the applicant "never indicated that deposition would not suffice to meet the limitations of the claims." (Pet. App. 86a)

Because these facts were never disavowed by either the district court or the court of appeals, they independently provide "substantial evidence" to support a jury verdict

rejecting prosecution history estoppel. *Sun Studs*, 872 F.2d at 987. Thus, this case squarely presents the question whether, in the absence of any unequivocal surrender of the equivalent subject matter, a patent holder is entitled to a jury trial on the application of prosecution history estoppel. That question is a recurring and fundamental question of patent law of the kind that this Court has routinely addressed and merits this Court's plenary review.

CONCLUSION

The petition for a writ of certiorari should be granted.

Respectfully submitted,

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March 1, 1999

APPENDICES

APPENDIX A

UNITED STATES COURT OF APPEALS FEDERAL CIRCUIT

Nos. 97-1137, 97-1153

EMI GROUP NORTH AMERICA, INC.,
Plaintiff-Appellant,

v.

INTEL CORPORATION,
Defendant/
Cross-Appellant.

Sept. 29, 1998

Rehearing Denied; Suggestion for
Rehearing In Banc Declined
Nov. 30, 1998 *

Before NEWMAN, PLAGER, and BRYSON, Circuit Judges.

PAULINE NEWMAN, Circuit Judge.

In this patent infringement case the United States District Court for the District of Delaware, following a two-day *Markman* hearing on the issue of "claim construction," granted summary judgment in favor of Intel Corporation, holding that three of Intel's manufacturing

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* Circuit Judges Clevenger and Schall did not participate in the vote.

processes do not infringe United States Patent No. 4,486,943 (the '943 patent) owned by EMI Group North America.[1] EMI appeals. Intel cross-appeals, *inter alia*, the ruling that Intel is not licensed under the '943 patent. We affirm the district court's judgment that the claims are not infringed, and dismiss the cross-appeal.

I

THE PATENTED INVENTION

The '943 patent, entitled "Zero Drain Overlap and Self Aligned Contact Method for MOS Devices," issued December 11, 1984, is directed to a method of fabricating metal oxide semiconductor (MOS) field effect transistors, used in the integrated circuits of computer memory and microprocessor chips. Each MOS transistor acts as a switch to turn an electric current on and off. A chip may contain as many as several million transistors.

MOS transistors are built on a wafer or "substrate" that forms the bottom of the transistor. A MOS transistor typically consists of a gate electrode that has been deposited on a thin dielectric (insulating) layer over the substrate, with electrically conductive "source" and "drain" regions formed in the substrate on opposing sides of the gate electrode. These conductive regions are separated by the "channel," a poorly conductive region under the gate electrode. The basic MOS structure of the prior art is illustrated as follows:

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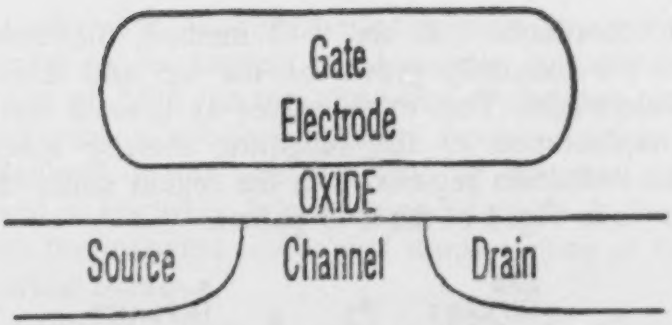
[1] *EMI Group N. Am., Inc. v. Intel Corp.*, C.A. No. 955-199-RRM (D. Del. May 1 & Oct. 31, 1996; Nov. 4, 1996) (partial summary judgment; Judgment); *Thorn Emi North Am., Inc. v. Intel Corp.*, 936 F.Supp. 1186, 928 F.Supp. 449 (D.Del.1996) (partial summary judgments).



Upon application of voltage to the gate electrode, current flows from the source to the drain region, emitting an electrical signal that contributes to the operation of the chip. When the gate voltage is discontinued, the transistor reverts to static mode and ceases to emit signals.

Various methods of manufacturing MOS transistors have been described, whereby a semiconductor is produced by forming a thin layer of dielectric material (the oxide in the illustration) on a silicon substrate, then depositing gate electrode material such as polysilicon on the dielectric layer, "doping" the polysilicon with activating ionic substances so that it will conduct electricity, and vertically implanting or doping the source and drain regions of the silicon substrate with ions so that they become conductive. The portion of the substrate under the gate electrode is shielded from the vertical ion implantation, whereby after implantation the edges of the source and drain regions are generally vertically aligned with the sides of the gate electrode.

After implantation, the entire structure is heated to activate the ions in the implanted regions, as is necessary to make the regions conductive. This step leads to an undesirable consequence because during this heating process the implanted ions tend to diffuse through the substrate. Diffusion under the gate electrode causes buildup of an electric change known as "Miller capacitance," which reduces the transistor's operating speed. The '943 patent is directed to a MOS transistor fabrication method that reduces the occurrence of Miller capacitance.

In accordance with the '943 method, dielectric oxide layers are thermally grown on the top and sides of the gate electrode. This oxide serves as a mask during the ion implantation of the substrate, thereby spacing the source and drain regions from the region under the gate, as shown in Fig. 1 of the '943 patent:

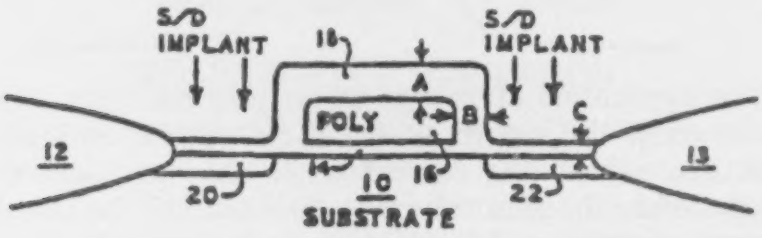


FIG.1

The dielectric oxide layers are differentially grown, meaning that the oxide (18) grown on the top and sides of the gate electrode (16) (POLY for polysilicon) is thicker than the oxide grown over the source and drain regions (20 and 22) of the substrate. The grown oxide on the top and sides of the gate electrode shields the gate electrode and the underlying portions of the substrate from ion implantation during creation of the source and drain regions, forming a gap that is free of implanted ions. Upon heat activation there is some migration of ions, but the conditions are controlled whereby there is substantially zero overlap in the vertical alignment of the gate electrode and the implanted source and drain regions. Since the ions do not migrate beyond the gap into the area underneath the gate electrode, Miller capacitance is avoided and operating speed is increased. Claim 1 of the '943 patent states the claimed process:

> 1. A method for fabricating on a substrate an MOS transistor having a gate electrode and a self-aligned source/drain region with zero overlap comprising:
>
> (a) forming a doped polysilicon gate electrode upon but insulated from the substrate; then

(b) differentially thermally growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode whereby a relatively thicker layer of oxide is developed on the top and sides of the gate electrode and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate; then

(c) anisotropically etching said oxide;

(d) implanting a source/drain region in the substrate such that said implant mask shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a side edge of the implanted region; and then

(e) heat driving the implanted source/drain region until its side edge is substantially aligned with the previously separated side edge of the gate electrode, whereby the source/drain edge is aligned with the gate electrode edge and there is substantially zero overlap.

EMI charged that certain of Intel's MOS transistor fabrication methods infringe claim 1, literally or under the doctrine of equivalents.

INFRINGEMENT

Determination of infringement entails a two-step analysis wherein the claims are first construed by the court as a matter of law, following which the construed claims are applied to the accused device or method, a question of fact. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976, 34 U.S.P.Q.2d 1321, 1326 (Fed.Cir. 1995) (in banc), *aff'd*, 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577, 38 U.S.P.Q.2d 1461 (1996). In *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1455, 46 U.S.P.Q.2d 1169, 1173 (Fed. Cir.1998) (in banc), the Federal Circuit confirmed that any disputed questions

concerning the meaning and scope of patent claims, including the meaning of technologic and other terms ("the totality of claim construction") are treated as questions of law and are determined *de novo* on appeal, without deference to the decision of the trial court.

On appeal of the district court's grant of summary judgment we first must construe the claims, and then apply the rules governing summary judgment to the district court's rulings on the factual issues of infringement. When disputed questions of material fact underlie the summary judgment "the evidence of the nonmovant is to be believed, and all justifiable inferences are to be drawn in his favor." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 254, 106 S.Ct. 2505, 91 L.Ed.2d 202 (1986). The appellate tribunal must assure itself that there is no reasonable version of the facts, on the summary judgment record, whereby the nonmovant could prevail, recognizing that the purpose of summary judgment is not to deprive a litigant of a fair hearing, but to avoid an unnecessary trial. *See id.* at 250, 106 S.Ct. 2505. On this basis the grant of summary judgment is reviewed *de novo* on appeal. *See, e.g., Stark v. Advanced Magnetics, Inc.*, 29 F.3d 1570, 1572-73, 31 U.S.P.Q.2d 1290, 1292 (Fed. Cir.1994).

The Markman Hearing

Construction of the claims by the trial court is often conducted upon a preliminary evidentiary hearing, called a *Markman* hearing in homage to the decision, cited *supra*, that established that this step must be performed by the judge, not the jury. This case illustrates the resolution of most of a complex infringement case with no more trial than a two-day *Markman* hearing.

At the *Markman* hearing the district court heard extensive testimony from the technical experts on the various issues and arguments concerning the scope of the claims in the context of the accused structures, and made findings thereon in construing the claims. The Federal Cir-

cuit has admonished that claims should preferably be interpreted without recourse to extrinsic evidence such as expert testimony, other than perhaps dictionaries or reference books, and that expert testimony should be received only for the purpose of educating the judge. *See Markman,* 52 F.3d at 983, 34 U.S.P.Q.2d at 1133 (expert testimony can not "relieve the court of its obligation to construe the claims according to the tenor of the patent. This opinion testimony also does not change or affect the *de novo* appellate review standard for ascertaining the meaning of the claim language.") In *Cybor* the court reaffirmed that extrinsic evidence including expert testimony is not to be relied upon for purposes of claim interpretation, other than to aid the judge in understanding the technology; such evidence is only "an aid to the court in coming to a correct conclusion as to the true meaning of the language employed in the patent." 138 F.3d at 1454 n.3, 1455-56, 46 U.S.P.Q.2d at 1173 n.3, 1174.

At the hearing the court received the testimony of expert witnesses for both sides. The witnesses explained the technology of MOS field effect transistor fabrication, analyzed the cited references, and testified as to the technologic facts of the patented and the accused processes and their effect. The expert witnesses discussed the specification and the prosecution history and the meaning of certain rejections, arguments, and amendments during patent prosecution. The expert witnesses expressed their views on the meaning and scope of the claims, as well as on legal and technologic issues relating to prosecution history estoppel and equivalency.

Following the *Markman* hearing the district court construed the scope of the claims, with respect particularly to the relative thickness of the grown oxide on the top of the POLY gate. This construction was dispositive of the issue of literal infringement. The district court granted Intel's motion for summary judgment that there was not

literal infringement, and a few weeks later upon Intel's renewed motion the court granted summary judgment that there was not infringement under the doctrine of equivalents. EMI argues that the district court incorrectly construed the claims, denying the patented invention its proper scope. EMI states that the court's overly narrow claim construction incorrectly excluded the accused Intel processes.

Several complex and disputed technologic questions have been raised concerning the scope of the claims and their construction, particularly in the context of the accused structures. In our *de novo* review we have considered the analysis and conclusions of the district court, as well as the testimony and opinions of the expert witnesses, in resolving these questions. Although both sides have attempted to provide basic education in this field of technology, our determination of the issues on appeal has drawn on the record of the *Markman* hearing and the testimony of the expert witnesses, including their conflicting views of the significance of various distinctions drawn during patent prosecution with respect to the prior art, as well as with respect to the accused Intel methods and their relation to the EMI method and prior art methods.

The Oxide Thickness, Claim Clause (b)

The district court construed clause (b) to require that the dielectric oxide grown on top of the gate electrode must be sufficiently thick of itself, without additional deposited dielectric, to serve as an implant mask for the gate electrode. This requirement is not stated in the '943 specification, but Intel argued that it is implicit in the patented invention, and that this can be discerned from the prosecution history and the prior art.

The issue was debated by the expert witnesses, who disputed the purpose of the grown oxide on top of the gate, applied the prior art to set limits to the top oxide thickness, and discussed the implications for Intel's proc-

ess. Drawing heavily on this testimony, the district court construed claim clause (b) to require the following characteristics of the grown oxide on the top and sides of the gate, some of which are stated in the claim and some of which are not:

> (1) the grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d);
>
> (2) the grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a "gap;" and
>
> (3) the top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness.

EMI assigns several errors to this claim construction. First, EMI argues that clause (b) does not require that the grown oxide on top of the gate electrode be sufficiently thick by itself to serve as a mask during implantation of the source/drain region. This aspect is relevant to the issue of infringement, for Intel adds dielectric to the top of the gate in order to achieve this masking result. EMI states that the doping (implanting) of the gate electrode itself is not part of the '943 invention, and that it is irrelevant to the construction of the claim to consider how the top of the gate is masked. EMI states that neither the specification nor the prosecution history concerns the mask thickness of the oxide on top of the gate, or whether that oxide is grown, or additional dielectric is deposited, or both. Thus EMI argues that the district court incorrectly construed the claim by imposing the enumerated limitations on the claim element of clause (b).

EMI points out that clause (b) as written requires only that the oxide grown on the top and sides of the gate electrode has a "controlled thickness," thicker than the oxide grown on the substrate (this is the agreed meaning of "differentially" growing), and requires only that

the grown oxide on top and sides "serves as an implant mask" during implanting of the source and drain regions. EMI states that this does not mean or require that the grown oxide must be sufficiently thick on top of the gate to serve as a complete implant mask to the gate electrode itself, which has already been doped. EMI states that the '943 claims do not exclude Intel's deposit of additional oxide on the top of the gate to add to the masking effect of the grown oxide. EMI argues that the phrase in clause (b) "having controlled thickness on both top and sides" refers, grammatically and technologically, to the term "oxide," not the term "implant mask." EMI states that the '943 patent is directed to masking the substrate during ion implantation of the drain and source regions, and that it is irrelevant how the top of the gate is shielded during this step.

Thus EMI argues that clause (b), correctly construed, requires only that the differentially grown oxide must have controlled thickness on the gate electrode as compared with the substrate, but does not also require the grown oxide on top of the gate electrode to serve as a total mask to the top of the gate during the implantation of the substrate in accordance with clause (d). EMI argues that the specification supports the claim construction that only the oxide grown on the sides of the gate electrode must serve as a complete mask to the underlying substrate, pointing out that column 3, lines 42-44, of the '943 patent states that "the oxide 18 on the sides of the gate electrode acts as an implant mask to shield underlying portions of the substrate from implantation."

During patent prosecution the claims were rejected on the ground of obviousness based on U.S. Patent No. 4,182,023 (the Cohen patent) in light of U.S. Patent No. 4,356,623 (the Hunter patent). The Cohen patent describes the implanting of MOS source and drain regions when there is formed on top of the gate electrode a layer of oxide slightly larger than the gate electrode, thereby

providing an overhanging mask that shields a portion of the substrate below the overhang during the vertical implantation of ions into the source and drain regions. The Hunter patent describes depositing an oxide layer over the top and sides of the gate electrode, then etching away the oxide on the top of the gate (so that the top can be implanted with dopant), leaving the oxide on the sides of the gate to serve as an implant mask for the substrate. To overcome the rejection on the combination of Cohen and Hunter, EMI amended clause (b), which had initially stated "forming an implant mask of a controlled width on the sides of the gate electrode" without mentioning the top of the gate electrode, to "forming an implant mask of a controlled thickness on both the sides and on the top of the gate electrode." EMI's patent attorney pointed out to the examiner that the Hunter patent required etching away the oxide on top of the gate electrode and,

> if enough oxide is etched away to permit implanting the source and drain, because there is *no differential*, between the gate oxide thickness and the source/drain oxide thickness, the gate would similarly be implanted. This too is a severe problem. [Emphasis in original.]

Thus EMI stressed to the PTO that in its invention failure to totally mask the gate would result in a "severe problem."

Again rejecting the pending claims, the examiner next cited the Steinmaier patent (U.S. Patent No. 4,139,402) in view of the Cohen patent. Steinmaier shows grown oxide on the top and sides of the gate, and was distinguished by the applicant's stressing that in the '943 invention the oxide was differentially thermally grown, that the gate was already doped before the oxide was grown, and that the oxide in Steinmaier was too thin to serve as an implant mask for the doped polysilicon or to prevent diffusion of ions from the source and drain regions into the area under the gate. The rejection was also based on

the Stoffel patent (U.S. Patent No. 4,287,661), which showed an implant mask having deposited oxide on top of the gate and grown oxide on the sides of the gate and on the substrate. EMI argued that Stoffel was distinguishable on the basis that,

> the top of the gate is covered with a coterminous layer of *deposited* silicon oxide. Next, to get to Fig. 4, a thermal growth occurs as described in column 4, lines 15-27. Clearly this oxidation is *entirely of polysilicon*, because polysilicon is the upper most layer. There is *no differential* growth because there is *only one substance* being oxidized. (A difference in thickness results only because there is the added thickness of deposited silicon oxide 32.) [Emphasis in original.]

At the same time, claims covering alternate embodiments, including those to composites of two dielectrics to mask the gate, were cancelled and claim 1 was amended and limited to "(b) differently thermally growing an implant mask of oxide . . . on the top and sides."

The oxide grown under the conditions of the '943 patent was consistently described to the examiner as having the advantage of producing a "relatively thicker" oxide covering the gate electrode. Although it is undisputed that Intel's grown oxide is also "relatively thicker" on the gate, it was stipulated that it is not thick enough to mask the top during ion implantation, and requires a supplemental deposit of dielectric material for that purpose. We observe that EMI's claims all state that the gate electrode is already "doped" before implantation of the source/drain region, see clause (a) of claim 1, thus requiring that the top be masked during implantation of the source/drain regions.

With the guidance of expert testimony on all of these issues raised by the prior art and the prosecution history, the district court held that the differentially thermally

grown oxide on top of the gate electrode in the '943 patent's process must be thicker than the oxide grown on the substrate by a ratio of at least 1.77 to 1. This ratio does not appear in the '943 specification, but is derived from the Steinmaier reference, which was distinguished during prosecution as inadequate to satisfy the masking requirements of the '943 process because the differential available from Steinmaier was only 1.77 to 1. Thus the district court placed this numerical threshold on the term "relatively thicker" in claim clause (b). EMI argues on appeal that the specification and claims require only that the oxide grown on top of the gate electrode is relatively thicker than the oxide grown over the substrate, that the prosecution history did not focus on the top thickness of the mask, which is irrelevant to the '943 invention, and that the numbers extracted from the prior art are inaptly imported into the '943 claims.

Although we agree with EMI that the 1.77 to 1 ratio is not the only way of defining "relatively thicker," it was presented to the examiner, in distinguishing the Steinmaier reference, as a ratio below which differential thermal growth is not deemed to be achieved. It was not incorrect for the district court to construe the claims as requiring at least the relative thickness that was invoked to distinguish the '943 method from the prior art. In all events, it is clear that the oxide grown on top of the gate must be thick enough to serve as a mask for the gate during the implant step (d), for this was the basis on which EMI overcame the final rejection on the Cohen and Steinmaier references; and EMI concedes that the differentially thermally grown oxide of Intel, without additional dielectric, does not mask the gate during step (d).

The "Implanted Region"

EMI states that the district court erred by equating "the implanted region" with "the source/drain region" at the stage of claim clause (b), EMI arguing that the source/drain region does not fully exist until after the heat activa-

tion step of clause (e). However, we observe that EMI's counsel as well as expert witnesses for both sides referred to this region as the source/drain region before as well as after heat activation. If there were technical error it is harmless, for there is no uncertainty as to the region of the transistor that was meant to be described.

In claim clause (d) the district court construed the phrases "implanted region" and "source/drain region" to mean "regions of opposite polarity as compared to the substrate surrounding them." This construction has not been challenged.

The "Gap"

EMI also criticizes the district court's construction of "gap" in claim clause (d). We do not discern the errors assigned by EMI. The district court defined the "gap" area as "a distance between a side edge of the gate electrode and a side edge of the implanted region." This definition had been refined, upon EMI's criticism, with the benefit of testimony of the expert witnesses. We confirm that this definition is correct. Again, there is no ambiguity as to the area that is intended to be described as the gap area.

The Side Edge

The district court defined the phrase "a side edge of the implanted region" in clause (d) to mean "where the concentration of N-type polarity equals the concentration of P-type polarity." EMI portrays this definition as deficient in several ways; in particular, EMI states that the district court confused "P+" and "N+", references to concentration, with "P-type" and "N-type", references to polarity.

Upon review of the expert testimony, the arguments, and the application of each claim step to the Intel process, we conclude that it is irrelevant whether the district court

achieved a technologically perfect definition, because there is no dispute that the corresponding step of the Intel process is within the literal scope of clause (d), however "the side edge" is defined. Thus we do not attempt to decide, *de novo*, the correct meaning of P+/N+ and P-type/N-type in this field of science and as used in the '943 patent to delineate the side edge of the source/drain region.

Substantially Aligned

The district court construed the phrases "substantially aligned" and "substantially zero overlap" to mean "the same as or very close to perfect alignment" and "the same as or very close to zero overlap," respectively. EMI does not challenge the latter definition, but contests the use of "perfect alignment" in defining "substantially aligned." According to EMI, the term "perfect" is superfluous and inappropriate. However, the district court extensively documented the statements in the '943 specification and the prosecution history that "perfect alignment," along with "zero overlap," was a key distinguishing aspect of this invention.

Upon review of these materials, we reach the same conclusion as did the district court. We also observe that this aspect of the claim construction does not affect the infringement decisions, which accepted that Intel employed, literally, the heat driving step of clause (e) to achieve the alignment and zero overlap required by clause (e).

Literal Infringement

The parties agree that if the district court's claim construction stands, Intel's process does not literally infringe claim 1. The parties stipulated facts which the district court held, on its claim construction, to warrant summary judgment that there was not literal infringement of claim 1. Specifically:

> [The parties] stipulate that the thermally grown oxide layer on the top of the gate electrode in the P650, P651, and P852 (revs.1-8) processes used by Intel to fabricate MOSFET transistors does not by itself mask the top of the gate electrode from the N+ and P+ implants at the energy levels used in said process for said implants.

We agree with the district court that if the claims are construed to require that the thermally grown oxide in clause (b) must be not only thicker on the top and sides than on the substrate, but also must be thick enough by itself to serve as an implant mask for the top of the gate electrode, there can not be literal infringement. Since we have confirmed the district court's ruling that claim 1 requires that the grown oxide on the top of the gate electrode must be sufficiently thick to mask implantation of the top of the gate, without augmentation with deposited dielectric, and in view of the stipulation quoted *supra*, we affirm that Intel's processes that are subject to this stipulation do not literally infringe claim 1.

The Doctrine of Equivalents

The doctrine of equivalents is intended to permit the patentee to enforce the patent against substantially the same invention, recognizing the strong constraints of the patent claims as the statement of the statutory patent right. Thus the doctrine of equivalents is invoked to prevent a "fraud on the patent," *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 94 L.Ed. 1097 (1950), when an accused infringer is "stealing the benefit of the invention" by making insubstantial changes that avoid the literal scope of the claims. *See Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 117 S.Ct. 1040, 137 L.Ed.2d 146 (1997).

Infringement by equivalents requires that "the accused product or process contain elements identical or equivalent to each claimed element of the patented invention." *Id.*

at ——, 117 S.Ct. 1040. For infringement of a process invention, all of the claimed steps of the process must be performed, either as claimed or by an equivalent step. *See Applied Materials, Inc. v. Advanced Semiconductor Materials Am., Inc.*, 98 F.3d 1563, 1574, 40 U.S.P.Q.2d 1481, 1489 (Fed.Cir.1996).

EMI states that even if Intel's accused methods do not literally infringe claim 1, they infringe under the doctrine of equivalents. EMI states, and Intel does not dispute, that the only difference is Intel's use of a composite dielectric of grown and deposited oxide on top of the gate, to mask the gate during implantation of the source/drain region. EMI states that this composite dielectric is equivalent to the grown oxide of claim clause (b) in its function, way, and result, and indeed is substantially the same. Intel responds that EMI is estopped by the prosecution history from invoking this equivalency as grounds of infringement.

EMI states that Intel's implant mask on the top of the gate electrode is the equivalent of the mask of claim clause (b) because Intel not only uses differentially thermally grown oxide, as stated in clause (b), but simply deposits additional dielectric material over the grown oxide. This composite layer is sufficiently thick to serve as an implant mask, which, according to EMI, is the identical function required by the claim, achieved in the same way with the same result. There is no dispute that this is what Intel does, and that it achieves the result of masking the gate electrode during implantation of the source/drain regions, as stated in the claim. According to EMI, Intel simply substitutes a known expedient for part of the grown oxide.

Equivalency is not defeated by using an additional step to achieve what the patentee does in one step. *See, e.g., Intel Corp. v. United States Int'l Trade Comm'n*, 946 F.2d 821, 832, 20 U.S.P.Q.2d 1161, 1171 (Fed.Cir. 1991) (infringement under the doctrine of equivalents

when a combination of components performed the function of a single element of the patented invention). Such a process may avoid the reach of the doctrine of equivalents, however, if the asserted variation had been relinquished during prosecution on grounds of patentability. *Warner-Jenkinson*, 520 U.S. at ——, 117 S.Ct. 1040; *Mannesmann Demag Corp. v. Engineered Metal Prods. Co.*, 793 F.2d 1279, 1284, 230 U.S.P.Q. 45, 47-48 (Fed. Cir.1986). Thus when claims are amended for reasons of patentability, it is necessary to determine the scope of the estoppel that has been incurred by the amendment. *See Hughes Aircraft Co. v. United States*, 140 F.3d 1470, 1477, 46 U.S.P.Q.2d 1285, 1289-90 (Fed.Cir.1998) (amendments made to overcome a prior art rejection narrow the range of equivalents accordingly; however, they do not, by the fact of amendment, precludes access to the doctrine of equivalents); *Litton Sys., Inc. v. Honeywell, Inc.*, 140 F.3d 1449, 1455, 46 U.S.P.Q.2d 1321, 1325 (Fed.Cir.1998) (equivalency must be determined on the facts of what was surrendered and why). We agree with EMI that, on the face of the differences between the Intel methods and the '943 claims, there is no substantial difference between the masking effect of differentially thermally grown oxide of a certain thickness, and the masking effect of differentially thermally grown oxide of a lesser thickness that is supplemented by deposited oxide to achieve the needed thickness. However, the district court determined that EMI is estopped from achieving the benefit of that equivalency.

EMI argues that no estoppel can flow from the amendment to clause (b) that resulted from the rejection based on the Steinmaier and Stoffel references. This amendment related to the differential thermal growing of relatively thick oxide and, in conjunction with a prior amendment, required such grown oxide on the top as well as the sides of the gate. In making this amendment, EMI drew the examiner's attention to the fact that, in contrast to Steinmaier, the *claimed* differentially thermally grown

oxide must be sufficiently thick to prevent ion implantation. Similarly, EMI distinguished Stoffel on the ground that the gate in Stoffel was covered with deposited material, not differentially thermally grown oxide, once again emphasizing that "the implant mask of step (b) [of EMI's claim 1] is specified to be thermally grown oxide." In view of these arguments made to distinguish Steinmaier and Stoffel, and the special significance placed on the use of a differentially thermally grown oxide layer that was by itself thick enough to prevent ion implantation, we conclude that EMI surrendered coverage to a mask consisting in part of differentially thermally grown oxide and in part of deposited material.

Along with its amendment to clause (b) to distinguish Steinmaier and Stoffel, EMI also cancelled claims covering composite masks, claims 8 and 23 in particular, albeit claims that did not specifically describe the Intel products. This combination of cancellations and amendments ultimately led to allowance of the claims in suit. Claims 8 and 23, as well as the other pending claims, had been rejected as unpatentable over the Steinmaier patent in view of Cohen, as well as over the Stoffel patent in view of Cohen. As discussed *ante,* Steinmaier describes forming an implant mask by thermally growing an oxide layer over the gate and substrate, while Stoffel teaches forming an implant mask by depositing oxide on top of the gate and then thermally, but nondifferentially, growing an oxide layer over the sides of the gate and the substrate. Although none of these references explicitly refers to composite dielectric layers as implant masks over a gate, the district court placed weight on the following argument of EMI's patent attorney when cancelling these claims:

> [A]pplicant considers that the rejections of claims on the basis of Steinmaier or Stoffel in combination with Cohen are infirm because these references do not suggest the use of differential thermal growth with a high differential rate to form a device according

> to claim 1. Further, none of the prior art suggests combining such differential thermal growth with anisotropic etching for this purpose. Third, none of the prior art is seen to suggest the combination of such differential thermal growth with such anisotropic etching combined with the self-alignment of contacts.

The court concluded that the emphasis on differential thermal growth constituted a surrender with respect to coverage of implant masks that were not differentially thermally grown, including composite dielectric masks.

We agree with EMI that the cancellation of its broad claims to composite masks was not a disclaimer of every possible composite mask. Cancellation of a claim that is written broadly does not always generate an estoppel to narrower subject matter. The particular facts must be considered. *See, e.g., Modine Mfg. Co. v. United States Int'l Trade Comm'n*, 75 F.3d 1545, 1555-56, 37 U.S.P.Q. 2d 1609, 1616 (Fed.Cir.1996) (Determination "is based on the reasonable reading, by a person of skill in the field of the invention, of the entire prosecution history."); *Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1218-19, 36 U.S.P.Q.2d 1225, 1230 (Fed.Cir.1995) (expert evidence of the significance of terms of art as used in the patent); *cf. Litton,* 140 F.3d at 1455, 46 U.S.P.Q. 2d at 1325.

Notwithstanding our conclusion that cancellation of claims to certain composite masks, by itself, did not effect an estoppel with respect to Intel's accused processes, we have determined that the district court correctly interpreted the prosecution history as a whole in estopping EMI. EMI specifically argued that the differentially thermally grown oxide on top of the gate masks the gate during the implant deposition of claim step (d), in response to rejections on prior art. The applicant had stressed to the examiner throughout the prosecution that the differential thermal growth of the masking oxide on the top and sides of the gate provided a patentable dis-

tinction from Hunter, Steinmaier, and Stoffel, as well as other references. The significance of a substantial differential in thickness of the thermally grown oxide of itself was emphasized by EMI in amendment and argument, accompanied by amendment or cancellation of claims not so limited. Although EMI now argues that the only important aspect of the '943 invention is the masking effect of the side oxide to produce the gap in the substrate, that is an inadequate view of the prior art and the prosecution of the claims, for the prior art showed side masks for the purpose here used, and the other limitations of the claims were relied upon to distinguish the various cited references. EMI had been steadfast in its argument that a patentable distinction from the prior art was the differentially thermally grown oxide to mask the top and sides of the gate, accompanied by amendments to limit the broadest remaining claim (now claim 1) to differentially thermally grown oxide "to serve as an implant mask," clause (b), the claim also requiring that the gate electrode had already been doped, clause (a), thus implicitly requiring masking during implant of the source/drain regions.

We thus affirm the district court's ruling that EMI is estopped to assert equivalency against Intel's combination of differentially thermally grown oxide and deposited dielectric on the gate when the differentially thermally grown oxide itself is not thick enough to mask the top of the gate from implant. EMI acknowledged to the examiner that, "Steinmaier is one of what must be a huge number of patents which relate to the formation of a transistor device," and in this congested art and in view of all of the cited references and the prosecution history, we agree that EMI is now estopped from asserting equivalency of Intel's composite dielectric, when the masking effect on the top of the gate is achieved only by an additional deposit of dielectric. The summary judgment of non-infringement under the doctrine of equivalents is affirmed.

II

THE INTEL CROSS-APPEAL

Intel raises two issues in its cross-appeal. First, Intel argues that summary judgment was inappropriately granted on the issue of the asserted license under the '943 patent. Second, Intel objects to the district court's ruling on an issue of privileged documents.

Intel states, and EMI does not disagree, that in the event of our affirmance of the judgments of non-infringement the cross-appeal need not be reached. Accordingly, the cross-appeal is dismissed.

Costs

No costs.

AFFIRMED; CROSS-APPEAL DISMISSED.

APPENDIX B

UNITED STATES DISTRICT COURT
D. DELAWARE

Civil Action No. 95-199-RRM

THORN EMI NORTH AMERICA, INCORPORATED,
Plaintiff,

v.

INTEL CORPORATION,
Defendant.

May 28, 1996

McKELVIE, District Judge.

This is a patent case. Plaintiff Thorn EMI North America, Inc. ("TENA") is the owner of U.S. Patent No. 4,486,943 ("the '943 patent"). The '943 patent claims an improved method for fabricating metal oxide semiconductor ("MOS") field effect transistors in a large scale integrated circuit. On March 29, 1995, TENA filed a complaint against defendant Intel Corporation ("Intel") alleging infringement of the '943 patent. On November 14, 1995, Intel filed a motion for partial summary judgment that Intel processes P652 and P852 (revisions 9 and 10) do not infringe the '943 patent. This is the court's decision on Intel's motion.

I. *FACTUAL AND PROCEDURAL BACKGROUND*

On January 31, 1996, the court held an oral argument on Intel's motion for partial summary judgment. The court

draws the following facts from the '943 patent claims and specification, the prosecution history of the '943 patent, the briefs of the parties submitted in connection wtih Intel's motion, the declarations of Dr. Fair, TENA's expert, and Dr. Chung, Intel's expert, and the oral argument.

A. *The Basic Technology Underlying This Lawsuit*

MOS field effect transistors, or simply MOS transistors, are devices found on integrated circuit computer chips, such as static random access memory chips ("SRAMs") and microprocessor chips. A typical microprocessor chip contains anywhere from several hundred thousand to several million MOS transistors. Each MOS transistor generates a signal by acting as a switch that can selectively turn on or off an electrical current. The signals generated by the MOS transistors on an integrated circuit chip control the operations of the computer.

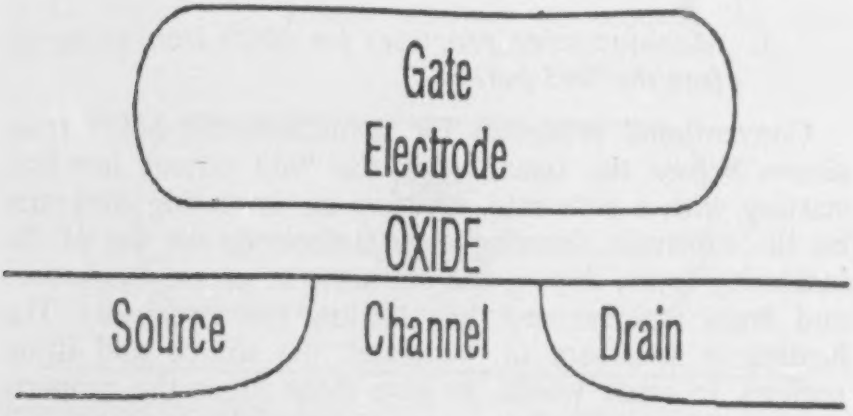
1. *The structure of an MOS transistor*

An MOS transistor generally consists of the following sections. First, there is the "substrate," which is the bottom layer of the transistor. The substrate is formed from a material, such as monocrystalline silicon, that is a poor conductor. Monocrystalline silicon is essentially a wafer of very pure glass made of a tightly packed and neatly organized single-crystal structure. Second, there is a "source" region at one end of the substrate and a "drain" region at the other end. The source and drain regions are areas of electrical conductivity that are formed by a process known as "doping." Doping involves implanting certain types of ions into the substrate. These ions, which are sometimes referred to simply as impurities, essentially "rain" down onto the ends of the substrate where they become embedded.

Third, there is a "gate electrode" formed on top of the substrate between the source and drain regions of the substrate. The gate electrode may be formed either from a

conductive material, such as a metal, or a non-conductive material, such as polysilicon. Polysilicon is made of loosely packed, minute pieces of silicon oriented differently from each other. If polysilicon is used, it also must be doped to become electrically conductive. Finally, the gate electrode is separated from the substrate by a relatively thin "dielectric," which is a material that does not conduct electricity. For example, a thin layer of oxide may separate the gate electrode and the substrate.

The following illustration demonstrates the various parts of an MOS transistor.



The name "metal oxide semiconductor" field effect transistor derives from the use of a metal gate electrode on top of the substrate, an insulating oxide layer between the gate electrode and the substrate, and a substrate made from a semiconductive material. However, the term "MOS field effect transistor" now refers to any transistor that has a conductive gate electrode on top of a semiconductive substrate with a layer of dielectric insulating the gate electrode from the substrate. For example, some of the MOS transistors manufactured by the processes claimed in the '943 patent do not require the use of a metal gate electrode or an insulating oxide layer.

2. *The operation of an MOS transistor*

MOS transistors operate in the following manner. When a voltage is applied to the gate electrode on top of the substrate, a channel opens between the source and drain regions within the substrate. This allows a current to flow through the transistor, between the source and drain regions and underneath the gate electrode. This current generates a signal that is communicated to various portions of a computer in combination with the signals from other MOS transistors on the integrated circuit chip. When the voltage is turned off, the transistor ceases to generate the signal.

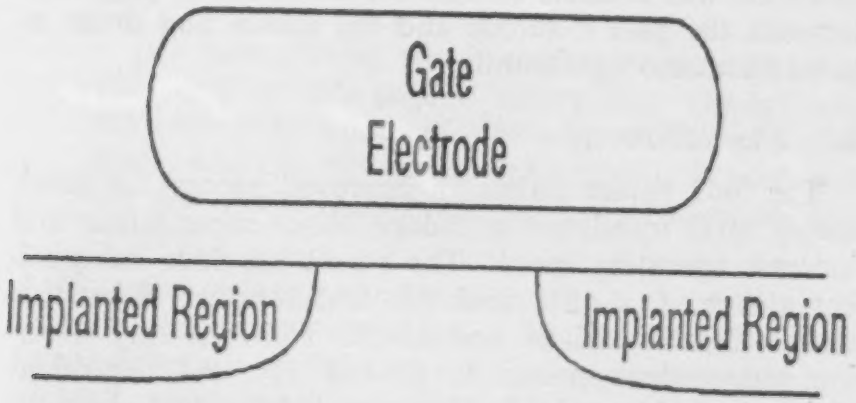
3. *Manufacturing processes for MOS transistors before the '943 patent*

Conventional processes for manufacturing MOS transistors before the issuance of the '943 patent involved starting with a substrate, forming an insulating dielectric on the substrate, forming a gate electrode on top of the insulating layer, doping the substrate to create the source and drain regions, and then heating the transistor. The heating is necessary to "activate" the source and drain regions, in other words, to give those areas the property of electrical conductivity. An incidental consequence of the heating step is that the ions, or impurities, in the substrate are driven deeper into the substrate and farther towards the center of the substrate. Those skilled in the art of making MOS transistors refer to this heating step as "heat driving" the source and drain regions. The movement of the source and drain regions toward the center of the substrate is referred to as "lateral diffusion."

Using conventional techniques known before the issuance of the '943 patent, each of these steps could be done in various ways. For example, the insulating dielectric could be deposited on top of the substrate, or it could be "grown" by heating the substrate in an oxygen oven. During the heating process, the top surface of the substrate is converted into another material, such as oxide,

in a manner similar to the way that metal rusts. In addition, the gate electrode could be deposited just in the middle on top of the substrate, or it could be deposited along the entire surface of the substrate and etched to remove the unnecessary portions. Finally, the gate electrode could be doped prior to the doping of the substrate, or it could be doped at the same time as the substrate.

A problem existed with these conventional techniques, however. When the source and drain regions were implanted, the edges of these regions were aligned vertically with the edges of the gate electrode before heat driving. Then the heat driving step would cause the source and drain regions to diffuse laterally underneath the gate electrode.



This "overlap" between the edges of the source and drain regions and the gate electrode caused something known in the field as "Miller capacitances." Miller capacitances reduce the operating speed of the transistor, which is an undesirable result because the speed of a transistor is the key to its functionality and commercial desirability. Ideally, to prevent the occurrence of Miller capacitances, the edges of the source and drain regions should be aligned vertically with the edges of the gate electrode *after* heat driving, rather than before.

To solve this problem, some of those skilled in the art of making MOS transistors proposed establishing a dielectric or a "photoresist" layer on top of the gate electrode material, then undercutting the gate electrode, which would leave an overhang of the dielectric or photoresist layer over the gate electrode. A photoresistive material is a material whose conductivity is affected by light or other radiation. The overhang existed to prevent implantation of the source and drain regions right next to the gate electrode. Therefore, the edges of the source and drain regions would be separated laterally from the edges of the gate electrode. Then the heat driving step would laterally diffuse the source and drain regions until those regions were aligned vertically with the edges of the gate electrode, thus leaving no overlap. In practice, however, the undercut was difficult to control, and vertical alignment between the gate electrode and the source and drain regions fluctuated significantly.

B. *The '943 Patent*

The '943 patent claims an improved process for fabricating MOS transistors to reduce Miller capacitances and increase operating speed. The patent has four independent claims, 1, 6, 10, and 15, and fourteen dependent claims, 2-5, 7-9, 11-14, and 16-18. TENA is only asserting independent claims 1, 6, and 15, and dependent claims 2, 3, 16, and 17. However, independent claim 10 is relevant to the parties' claim construction arguments.

1. *The claims of the '943 patent*

Independent claim 1 reads as follows:

> 1. A method of fabricating on a substrate an MOS transistor having a gate electrode and a self-aligned source/drain region with zero overlap comprising:
>
> (a) forming a doped polysilicon gate electrode upon but insulated from the substrate; then

(b) differentially thermally growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode whereby a relatively thicker layer of oxide is developed on the top and sides of the gate electrode and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate; then

(c) anisotropically etching said oxide;

(d) implanting a source/drain region in the substrate such that said implant mask shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a side edge of the implanted region; and then

(e) heat driving the implanted source/drain region until its side edge is substantially aligned with the previously separated side edge of the gate electrode, whereby the source/drain edge is aligned with the gate electrode edge and there is substantially zero overlap.

Anisotropic etching, mentioned in step (c) of claim 1, refers to the process of removing surface material in different directions at different rates, as opposed to isotropic etching, which involves removing surface material in all directions at the same rate. The role of anisotropic etching will become clear below in discussing the preferred embodiment of the '943 patent. The language of dependent claims 2 and 3, although asserted by TENA, is not relevant to Intel's motion.

Independent claim 6 reads as follows:

6. A method of fabricating on a substrate an MOS transistor having a gate electrode and a self-aligned source/drain region comprising:

(a) forming a doped polysilicon gate electrode insulated from the substrate;

(b) growing a dielectric layer over the gate electrode by a process controlled to develop a high differential of dielectric thickness such that the dielectric is relatively thick over the top and sides of the gate electrode and relatively thinner over the intended source/drain regions;

(c) anisotropically etching said dielectric layer;

(d) implanting the source/drain region such that its edge is laterally offset from the substrate area below the gate electrode due to said dielectric layer being present on the sides of the gate electrode;

(e) heat driving the source/drain region laterally until its edge is substantially vertically aligned with the side of the gate electrode;

(f) etching contact area to expose a part of the source/drain region and yet maintaining the dielectric on the top and sides of the gate electrode; and

(g) forming a conductive contact in the etched area, wherein the source/drain region is properly aligned with the gate electrode and the conductive contact is aligned with the source/drain region without shorting the gate electrode.

Steps (f) and (g) relate to forming contact areas on top of the transistor, which part of the process is not directly relevant to this litigation. However, these steps will assist in interpreting the language used in earlier steps of the entire process outlined in claim 6.

Independent claim 10, which TENA originally asserted in this litigation but ultimately withdrew, reads as follows in relevant part:

10. A method of fabricating a self-aligned semiconductor device having a gate, a source, and a drain with zero overlap comprising:

(a) forming a defined gate electrode insulated from and over a substrate, said gate electrode being polysilicon which is doped to promote a high rate of differential thermal oxidation, said substrate being monocrystalline silicon; then

(b) establishing an isolating oxide layer on the top and sides of said gate electrode by thermal oxidation under ambient conditions controlled such that the oxide layer covers the top and sides of the gate electrode and regions in the substrate where the source and drain will be formed, the oxide growing substantially thicker on the top and sides of the gate electrode than above the prospective source and drain;

. . . .

Independent claim 15 reads as follows:

15. A method of fabricating on a substrate an MOS transistor having gate electrode and a self-aligned source/drain region with zero overlap comprising:

[(a)] forming a doped gate electrode insulated from the substrate, said substrate being monocrystalline silicon; then

[(b)] establishing an isolating oxide on the top and sides of the gate electrode and over the substrate adjacent the gate electrode such that the oxide on the top and sides of the gate electrode is relatively thick compared to the oxide over the substrate, including oxidizing in a steam atmosphere at a temperature which promotes high differential rates of growth of oxide as between the doped poly gate electrode and the substrate;

[(c)] anisotropically etching the oxide at the top of the gate electrode and the intended source/drain region to leave oxide on at least the sides of the gate electrode;

[(d)] implanting a source/drain region in the substrate so that the oxide on the sides of the gate shield the underlying portion of the substrate from implantation thereby to provide a gap between a side edge of the gate electrode and side edge of the implanted region; then

[(e)] heat driving said implanted source/drain region so that its side edge can be substantially aligned with the previously separated side edge of the gate electrode and no substantial gap or overlap exists between the source/drain region and the gate electrode.

Dependent claim 16 reads as follows:

16. A method as set forth in claim 15 wherein the source/drain region is implanted while the top of the gate electrode is substantially free of dielectric for doping the gate electrode during source/drain implantation.

Dependent claim 17 reads as follows:

17. A method as set forth in claim 15 wherein a relatively thin oxide is formed over the gate electrode, the dielectric remnants and the intended source/drain region prior to implantation.

By definition, dependent claims 16 and 17 contain all of the limitations of independent claim 15. *See* 35 U.S.C. § 112.

2. *The preferred embodiment of the '943 patent*

The specification sets out the preferred embodiment of the invention claimed in the '943 patent. First, a layer of oxide is formed upon a substrate. Second, a doped polysilicon layer is defined and etched on top of the layer of oxide to form a gate electrode. Third, a dielectric layer, such as oxide, is grown on top of the gate electrode and the substrate by steam oxidation at 850°C. The resulting

oxide layer "on the top and sides of the gate electrode is relatively thick compared to the oxide layer adjacent the gate electrode over the intended source/drain regions." For example, the thickness of oxide over the top and sides of the gate electrode is 500 nanometers, where as the thickness over the substrate is 170 nanometers. This varying thickness occurs "because the oxide grows faster over the top and sides of the doped gate electrode." This third step is called "differential thermal growth" in the patent.

Figure 1 from the '943 patent illustrates the result of these first three steps, where 10 is the substrate, 14 is the insulating layer of dielectric, 16 is the doped gate electrode, 18 is the differentially grown oxide layer, and 2Q(20) and 22 are the source and drain reigons.

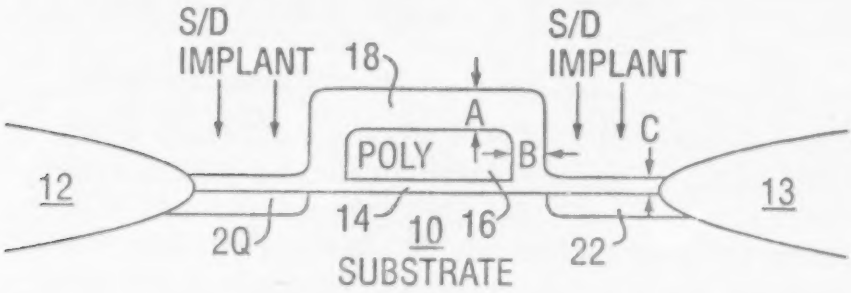


FIG. 1

Fourth, source/drain regions are implanted with arsenic or phosphorous ions. During this fourth stage, the differentially thermally grown oxide layer serves as an "implant mask" to prevent these impurities from being implanted next to the gate electrode:

> Because of the masking effect provided by the oxide on the sides of the gate electrode, the source-drain regions are not implanted adjacent to the vertical edges of the gate electrode. Rather, a gap is provided between the gate electrode and the source/drain regions to allow for subsequent diffusion of the source/drain regions.

Fifth, the source/drain regions are heat driven into the substrate until the edges of the regions are substantially vertically aligned with the edges of the gate electrode. After this heat treatment, certain additional steps are performed to form contact regions. These process steps are not relevant to the present litigation.

Figure 2 from the '943 patent illustrates the result of these remaining steps, where the source and drain regions (2Q (20) and 22) are substantially vertically aligned with the edge of the gate electrode (16).

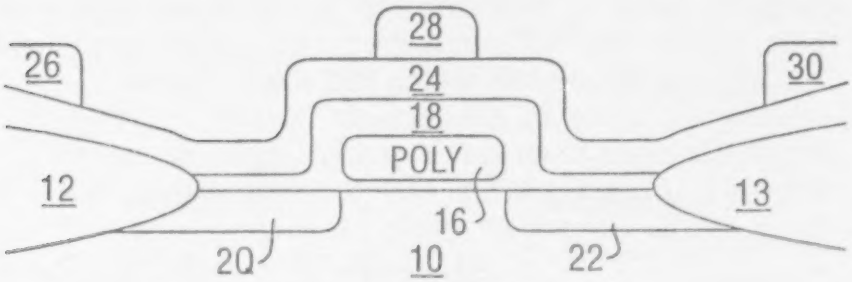


FIG. 2

There are a few inconsistencies between the specification and the claims of the '943 patent that bear noting. The specification purports to teach that, prior to the implantation stage, an *optional* anisotropic etch can be used to shape the differentially thermally grown oxide layer. For example, the specification states that an anisotropic etch can be used to thin or remove the layer of oxide over the substrate in order to increase the penetration of the implanted impurities. In addition, the specification suggests that an anisotropic etch can be used to thin the oxide on the sides of the gate electrode to create a smaller gap between the edges of the source/drain regions and the gate electrode. However, the claims all *require* that an anisotropic etch be performed before the implantation

stage. Thus, to the extent that the specification teaches a process without anisotropic etching, that process would appear to fall outside the scope of the patent claims.

The specification also purports to teach "Alternative Techniques" to the preferred embodiment that do not involve differential growth of the oxide layer over the gate electrode and substrate. For example, these alternative techniques involve depositing nitride or silicon dioxide instead of growing an oxide. However, each of the claims of the '943 patent requires *growth* of a dielectric layer, and each requires that growth to be *differential.* Moreover, independent claims 1, 10, and 15 require the dielectric to be oxide. Thus, because these alternative techniques do not involve differential growth of a dielectric layer, this portion of the specification does not appear relevant to the claims as issued.

C. *Intel's Accused Processes*

TENA asserts that a number of Intel processes infringe the '943 patent, including Intel processes P652 and P852 (revs. 9 and 10). Intel argues that the P652 and P852 (revs. 9 and 10) processes do not infringe the '943 patent because these processes do not involve doping the gate electrode prior to differentially growing a dielectric layer over the MOS transistor, as is required by the patent. TENA denies that the '943 patent requires the manufacturer to dope the gate electrode prior to the differential growth step. Alternatively, TENA asserts that a genuine issue of material fact exists as to whether Intel does in fact dope the gate electrode prior to the differential growth step of the P652 and P852 (revs. 9 and 10) processes.

II. *DISCUSSION*

A. *What is the Standard for Summary Judgment?*

Summary judgment is appropriate when the evidence admissible at trial fails to demonstrate a genuine issue of

material fact and when the moving party is entitled to judgment as a matter of law. *See, e.g., Brewer v. Quaker State Oil Refining Corporation*, 72 F.3d 326, 329 (3d Cir.1995). In this case, Intel must show that TENA has presented insufficient evidence to carry its burden of persuasion at trial that Intel's processes infringe the '943 patent. *Id.* If Intel meets this burden, TENA must create a genuine issue of material fact such that a reasonable jury could return a verdict in its favor. *Id.* at 330 (citing *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248, 106 S.Ct. 2505, 2510, 91 L.Ed.2d 202 (1986)).

To determine whether Intel is entitled to a judgment as a matter of law that its processes do not infringe the '943 patent, the court must perform a two-step process. The court first must construe the claims of the patent. *Texas Instruments, Inc. v. United States International Trade Commission*, 988 F.2d 1165, 1171 (Fed.Cir.1993). The court then must compare the properly construed claims of the patent to the accused processes to determine if all of the limitations in the claims are present in these accused processes. *Johnston v. IVAC Corporation*, 885 F.2d 1574, 1577 (Fed.Cir.1989).

The construction of patent claims is a matter for the court. *Markman v. Westview Instruments, Inc.*, —— U.S. ——, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). In construing the words and phrases in a claim, the court should give those words and phrases their ordinary meaning, unless the specification clearly indicates that the inventor intended a different meaning. *Intellicall, Inc. v. Phonometrics, Inc.*, 952 F.2d 1384, 1388 (Fed.Cir.1992). The court may also consider other words in the claim, other claims in the patent, the specification, the prosecution history, and expert testimony and other evidence outside of the patent. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979-81 (Fed.Cir.1995); *Elf Atochem v. Libbey-Owens-Ford Co.*, 894 F.Supp. 844, 859 (D.Del.1995).

B. *What are the Disputed Issues of Claim Construction?*

Intel presents one general claim construction question with respect to all of the claims of the '943 patent: Must the gate electrode be doped prior to differentially thermally growing the dielectric over the gate electrode, or can the gate electrode be doped during a later step of the process? Intel argues that the plain language of independent claims 1, 6, and 15 requires the manufacturer to dope the gate electrode prior to the differential thermal growth step. Furthermore, Intel argues that the specification and the prosecution history demonstrate the importance of doping for differential growth. TENA argues that differential growth can occur without doping, and that the claims allow for doping to occur at any time during the fabrication of an MOS transistor. Moreover, TENA argues that the specification and the prosecution history teach that doping may occur at any time and that the differential growth required by the patent does not require prior doping.

Examining independent claim 1 in light of Intel's general claim construction question, the court must construe the meaning of the phrases "forming a *doped* gate electrode . . .; *then*" in step (a), and "*differentially* thermally *growing* in oxide . . . whereby a *relatively thicker* layer of oxide is developed on the top and sides of the gate electrode and a *relatively thinner* layer of oxide is developed on the intended source and drain regions of the substrate" in step (b) (emphasis added).

Examining independent claim 6 in light of Intel's general question, the court must construe the meaning of the phrases "forming a *doped* polysilicon gate electrode" in step (a), and "*growing* a dielectric layer over the gate electrode by a process controlled to develop a *high differential of dielectric thickness* such that the dielectric is *relatively thick* over the top and sides of the gate electrode and *relatively thinner* over the intended source/drain regions" in step (b) (emphasis added).

Examining independent claim 15 in light of Intel's general question, the court must construe the meaning of the phrases "forming a *doped* gate electrode . . .; *then*" in step (a), and "*establishing* an isolating oxide on the top and sides of the gate electrode and over the substrate adjacent the gate electrode such that the oxide on the top and sides of the gate electrode is *relatively thick compared to the oxide over the substrate*, including oxidizing in a steam atmosphere at a temperature which promotes *high differential rates of growth* of oxide as between the *doped* poly gate electrode and the substrate" in step (b) (emphasis added).

C. *What Does the Plain Language of the Claims Suggest?*

The sequential order and language of claims 1, 6, and 15 suggests that doping must occur prior to the differential dielectric growth step. Step (a) in each claim recites a "doped" gate electrode, whereas step (b) in each claim recites differential dielectric growth. The ordering of the steps in this manner by itself implies a sequence. In addition, claims 1 and 15 both recite step (a) "then" step (b). The use of the word "then" further implies a sequence requiring doping first and then differential dielectric growth. Finally, step (b) of claim 15 includes steam oxidation that "promotes high differential rates of growth of oxide between the *doped* poly gate electrode and the substrate" (emphasis added). By referring back to structure formed in step (a), the use of the word "doped" in step (b) further implies that the doping must occur prior to the differential dielectric growth step. *See Loral Fairchild Corp. v. Victor Co. of Japan, Ltd.*, 906 F.Supp. 798, 805 (E.D.N.Y.1995) (stating that the ordering of the steps of a process patent in combination with language in subsequent steps referring back to structure formed in previous steps strongly suggests that the steps must proceed in chronological order).

The use of the term "differential" in step (b) of claims 1, 6, and 15 also suggests that doping must occur prior to the dielectric growth step. It is known in the art that doping the gate electrode prior to growing a dielectric layer over the entire MOS transistor will cause the oxide to grow much faster over the doped gate electrode as compared to over the undoped substrate. For example, claim 10 itself recites that the gate electrode "is doped to promote a high rate of differential thermal oxidation." Thus, an individual skilled in the art of making MOS transistors might consider the recitation of a "doped" gate electrode in step (a) as a necessary requirement for producing the required differential thermal growth of step (b). Between the sequential ordering of the steps and the scientific logic of the sequence from the perspective of those skilled in the art of making MOS transistors, the common sense reading of claims 1, 6, and 15 would require the doping of the gate electrode to occur prior to differential dielectric growth.

Finally, with respect to claim 6, steps (f) and (g) recite that the dielectric layer grown during step (b) must remain on top of the gate electrode even after the contact points have been formed. This requirement suggests that it would be practically impossible to dope the gate electrode after the dielectric growth step. The declaration of Dr. Chung, Intel's expert, states that "one skilled in the art [of making MOS transistors] would not believe that it would be practical to dope the polysilicon after the thick dielectric is formed on the polysilicon because that thick dielectric would make it difficult to access the polysilicon to dope it." Therefore, this additional limitation of claim 6 confirms as a practical matter that doping must occur prior to the dielectric growth step.

D. *What are TENA's Arguments In Opposition to This Construction Based on the Plain Language of the Claims?*

TENA makes five arguments in opposition to this plain meaning construction of the claims. First, TENA argues that the patent does not teach, and those skilled in the art were unaware at the time the '943 patent issued, that doping must precede dielectric growth. Second, TENA argues that because the explicit language of claim 10 requires doping prior to differential growth, and because the same language is missing from claims 1, 6, and 15, that the doctrine of claim differentiation prevents the court from construing such a limitation into claims 1, 6, and 15. Third, TENA argues that the word "then" was added to the claims before the word "doped" and thus does not relate to the sequence of when the gate electrode must be doped. Fourth, TENA argues that dependent claims 16 and 17 do not require doping prior to differential growth, and thus the court cannot construe independent claim 15 to have such a limitation. Fifth, TENA argues that the prior art does not require prior doping of the gate electrode in order to render the '943 patent non-obvious. As set out below, these arguments are unavailing in light of the plain claim language, the specification, and the prosecution history.

1. *Does the patent teach that doping must precede dielectric growth?*

TENA argues that those skilled in the art would have been unaware that doping must precede dielectric growth in the '943 patent. First, TENA asserts that the patent does not teach that doping promotes differential growth. Rather, TENA argues that those skilled in the art would understand doping only to refer to improving the electrical conductivity of the gate electrode, which suggests that doping can occur at any time during the process. Second, TENA argues that the "Alternative Techniques"

section of the specification describes a version of the patented process that dopes the gate electrode after dielectric growth. Third, TENA argues that the final paragraph of the specification, which states that "the sequence in which some steps are practiced may be altered to suit a particular application or processing environment," indicates that doping need not occur prior to the differential thermal growth step.

Contrary to TENA's first assertion, claim 10, at column 10, lines 7-9, and the specification, at column 3, lines 30-33, specifically state that doping increases differential dielectric growth. Therefore, even if those skilled in the art were not aware prior to the issuance of the patent that doping promotes differential growth, the patent clearly teaches that effect. In addition, as set out above in the description of the preferred embodiment, the "Alternative Techniques" do not involve differential dielectric growth and thus do not appear relevant to the patent claims as issued. According to Dr. Chung's declaration, the initial claims in the '943 patent did not require differential growth and thus supported this section of the specification. However, when Mr. Manzo, the prosecuting attorney for the '943 patent, added the differential growth limitation during the prosecution, these "Alternative Techniques" became irrelevant. Based on the prosecution history as set out below in the discussion of TENA's claim differentiation argument, Dr. Chung's characterization appears to be correct.

Even if these "Alternative Techniques" were relevant, however, the mere fact that doping *can* occur at any stage of the process in order to give the gate electrode its *electrical conductivity* does not answer the question of whether the patent claim nevertheless *require* doping prior to the growth of the dielectric to promote *differential growth*. TENA cannot use the "Alternative Techniques" section or the generic catch-all paragraph at the end of the specification to overcome specific limitations of the claims. *See Unique Concepts, Inc. v. Brown*, 939 F.2d 1558, 1562

(Fed.Cir.1991) (stating that a patentee cannot use the specification to avoid specific limitations of his claims and to interpret a claim contrary to its plain meaning).

2. *Does the doctrine of claim differentiation prevent the court from construing claims 1, 6, and 15 to require doping prior to dielectric growth?*

TENA admits that claim 10 requires doping prior to dielectric growth. However, TENA argues that the language of claim 10 that requires this limitation, read in connection with the prosecution history, establishes that prior doping is required only for the differential growth of claim 10. Thus, under the doctrine of claim differentiation, the court cannot construe claims 1, 6, and 15 to require doping for differential growth. TENA's argument requires a detailed examination of the relevant prosecution history.

a. *A chronology of the relevant prosecution history*

1) *The language of the claims as filed*

When Manzo first filed the application that resulted in the '943 patent, the patent had only two independent claims. These two claims ultimately issued as claims 1 and 6 of the '943 patent. As initially filed, claim 1 stated in relevant part:

. . . .

(a) forming a gate electrode insulated from the substrate;

(b) forming an implant mask of a controlled width on the sides of the gate electrode;

. . . .

As initially filed, claim 6 stated in relevant part:

. . . .

(b) defining a polysilicon gate electrode over the gate insulator between the intended source/drain regions;

> (c) establishing a dielectric layer over the gate electrode and the gate insulator such that the dielectric is relatively thick at least over the sides of the gate electrode and relatively thinner over the intended source/drain regions
>
> . . . .

Neither claim 1 nor claim 6 contained the words "doped" or "then" or the phrases "differentially thermally growing" or "differential growth." However, claim 6 contained language suggesting that a differential must exist between the dielectric over the sides of the gate electrode, where it must be "relatively thick," and over the intended source/drain regions, where it must be "relatively thinner."

2) *The first rejection and amendment*

The Patent and Trademark Office ("PTO") examiner rejected TENA's claims as obvious in light of the combination of U.S. Patent No. 4,182,023 issued to Cohen *et al.* (the "Cohen patent") and U.S. Patent No. 4,234,362 issued to Riseman (the "Riseman patent"). The examiner observed that Cohen discloses a layer of oxide overhanging the gate electrode that acts as a shield to prevent the source/drain regions from being implanted next to the gate electrode. Therefore, a subsequent heat driving step would laterally diffuse the edges of the source/drain regions until they were in substantial alignment with the edges of the gate electrode.

In response to this rejection, Manzo added the word "then" after step (a) of claim 1. To explain this change, Manzo stated that the Cohen patent requires the implant mask to be formed before or simultaneously with the gate electrode. Conversely, the invention of the '943 patent forms the gate electrode and "then" forms the implant mask. Although Manzo did not add the word "then" to claim 6, it appears from his argument that the sequence of forming the gate electrode prior to forming the implant mask was important in distinguishing the Cohen patent.

3) *Subsequent rejections and amendments*

Manzo filed additional amendments to the two independent claims in response to two subsequent rejections that are not relevant here. However, Manzo did file two relevant new independent claims, which ultimately issued as claims 10 and 15 of the '943 patent. As initially filed, claim 10 stated in relevant part:

> . . . .
>
> (a) forming a defined gate insulated from and over a substrate; then
>
> (b) establishing an isolating oxide layer of controlled dimensions by a *differential thermal growth* process such that the oxide layer covers the top and sides of the gate and regions in the substrate where the source and drain will be formed, the oxide being *thicker* on the top and sides of the gate than above the prospective source and drain; then
>
> . . . . (emphasis added)

As initially filed, claim 15 stated in relevant part:

> . . . .
>
> [(a)] forming a gate electrode insulated from the substrate; then
>
> [(b)] establishing a dielectric on the top and sides of the gate electrode and over the substrate adjacent to the gate electrode such that the dielectric on the top and sides of the gate electrode is *relatively thick* compared to the dielectric over the substrate;
>
> . . . . (emphasis added)

Thus, claim 10 was the first independent claim specifically to recite "differential thermal growth." Claims 6 and 15 contained language suggesting some differential between the dielectric layer over the gate electrode and the layer over the substrate, albeit not necessarily from thermal growth.

Manzo also amended some of the dependent claims in ways that are relevant to the present discussion. In particular, he added differential thermal growth to some of the dependent claims to establish a more narrow basis for patentability. In addition, he further added anisotropic etching to some of these dependent claims. Manzo argued that, at a minimum, the prior art never suggested using differential thermal growth in combination with anisotropic etching to make a zero overlap MOS transistor.

4) *Final rejection*

The examiner issued a final rejection of all of the claims in spite of these amendments. Specifically, the examiner stated that the claims were obvious in light of the combination of the Cohen patent and U.S. Patent No. 4,139,402 issued to Steinmaier *et al.* (the "Steinmaier patent"):

> Steinmaier et al[.] discloses forming an insulated polysilicon gate on a substrate, growing a thermal oxide over the gate and substrate, implanting source and drain regions on either side of the gate through the thin oxide over the substrate, heat driving the source and drain, and forming contacts. The thermally grown oxide is inherently thicker on the top and sides of the polysilicon gate than on the silicon substrate. . . . It would be obvious to routinely optimize the process of Steinmaier et al[.] to obtain the advantages of the aligned, nonoverlapping gate structure of Cohen et al.

Thus, the examiner determined that even the dependent claims, some of which contained both differential thermal growth and anisotropic etching, were obvious in light of the prior art.

5) *Manzo's "First Proposed Amendment"*

In his "First Proposed Amendment After Final Rejection," Manzo made substantial changes to the patent claims. He amended claim 1 to state in relevant part:

. . . .

(a) forming a *doped* polysilicon gate electrode upon but insultated [sic] from a monocrystalline silicon substrate; then

(b) *differentially thermally growing* an implant mask of oxide of a controlled thickness on both the sides and on the top of the gate electrode *including controlling ambient conditions* to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate, whereby a *relatively thicker* layer of oxide is developed on the top and sides of the gate and a *relatively thinner* layer of oxide is developed on the intended source and drain regions of the substrate; then. . . . (emphasis added)

Manzo amended claim 6 to state in relevant part:

. . . .

(b) forming a *heavily doped* polysilicon gate electrode over the gate insulator . . .; then

(c) establishing a dielectric layer over the gate electrode . . . by a process controlled to develop a *high differential of dielectric thickness* as between the gate and other areas such that the dielectric is relatively thick over the top and sides of the gate electrode and relatively thinner over the intended source/drain regions;

. . . . (emphasis added)

Manzo amended claim 10 to state in relevant part:

. . . .

(a) forming a defined gate insulated from and over a substrate, said gate being *doped to promote a high*

rate of differential thermal oxidation, said substrate being monocrystalline silicon; then

(b) establishing an isolating oxide layer on the top and sides of said gate by *thermal oxidation under ambient conditions* controlled such that the oxide layer covers the top and sides of the gate and regions in the substrate where the source and drain will be formed, the oxide growing *substantially thicker* on the top and sides of the gate than above the prospective source and drain; then

. . . . (emphasis added)

Finally, Manzo amended claim 15 to state in relevant part:

. . . .

[(a)] forming a gate electrode insulated from the substrate, said *gate* being polysilicon *doped to a sheet resistance of about 20 ohms per square*, said substrate being monocrystalline silicon; then

[(b)] establishing a dielectric on the top and sides of the gate electrode and over the substrate adjacent to the gate electrode such that the dielectric on the top and sides of the gate electrode is *relatively thick* compared to the dielectric over the substrate, said establishing step including *oxidizing in a steam atmosphere* at a temperature which promotes *high differential rates of growth* as between the *doped* poly gate and the substrate;

. . . . (emphasis added)

When Manzo submitted these amendments, he explained in detail the reasons for the changes. In particular, he focused on the examiner's conclusion as a part of his final rejection that the Steinmaier patent inherently disclosed differential growth. Manzo argued that although some differential growth does occur between a gate electrode constructed of one material and a substrate constructed of another, as in the Steinmaier patent, this dif-

ferential is very small. He argued that differential dielectric growth is more dependent upon the doping of the elements and the ambient conditions, which include the temperature and water content of the atmosphere during the dielectric growth step.

In support of his arguments, Manzo submitted an article by T.I. Kamins entitled "Oxidation of Phosphorous-Doped Low Pressure and Atmospheric Pressure CVB Polycrystalline-Silicon Films," in Volume 126 of the *Journal of the Electrochemical Society: Solid State Science and Technology* (May 1979) (the "Kamins article"). Manzo stated that the Kamins article demonstrates that when an undoped polysilicon gate electrode on a monocrystalline substrate is placed in a dry oxygen gas atmosphere over a temperature range of 950°C to 1150°C, there will be 7% to 9% greater thickness of oxide on the gate electrode. However, based on the Kamins article, Manzo stated that when the ambient conditions are changed to include a steam atmosphere, a differential of 30-35% results. Moreover, Manzo stated that if the gate electrode is doped first, the Kamins article demonstrates that a differential of 300% results.

Manzo contrasted the Steinmaier patent by observing that it recited dielectric layers of "substantially equal thickness" because it involved dry oxidation without doping. He emphasized that in the Steinmaier patent, "polysilicon gate 14 is *not doped* at the time of oxidation" (emphasis in original). He then described the preferred embodiment of the '943 patent, stating that doping of the gate electrode to a sheet resistance of 20 ohms per square is *"very substantial doping"* (emphasis in original). Manzo further stated:

> It will be appreciated that the poly[silicon gate electrode] oxide grows about 300% faster than the monocrystalline silicon [substrate] oxide. This accords with the teachings of Kamins in Table I which shows that at a temperature of 850°[C], the differ-

> ential between highly doped polysilicon and slightly doped crystal silicon in a steam atmosphere is 327%. This is *an enormous difference in kind* between the dry oxidation of an undoped polysilicon gate on an exposed single crystal silicon substrate, where the differential is [7%]. (emphasis in original)

Thus, Manzo distinguished the inherent differential growth between an undoped polysilicon gate electrode and a monocrystalline silicon substrate, as shown by the Kamins article and the Steinmaier patent, from the differential growth of the '943 patent.

The changes to the claims reflect Manzo's arguments that doping and ambient conditions create greater differential growth than recognized by the Steinmaier patent. To claim 1 he added "doped" and "controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate, whereby a relatively thicker layer of oxide is developed on the top and sides of the gate and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate." To claim 6 he added "heavily doped" and "a process controlled to develop a high differential of dielectric thickness as between the gate and other areas." To claim 10 he added "doped to promote a high rate of differential thermal oxidation" and "thermal oxidation under ambient conditions controlled such that . . . the oxide grow[s] substantially thicker on the top and sides of the gate than above the prospective source and drain." Finally, to claim 15 he added "doped to a sheet resistance of about 20 ohms per square" and "establishing a dielectric . . ., said establishing step including oxidizing in a steam atmosphere at a temperature which promotes high differential rates of growth as between the doped poly gate and the substrate."

The examiner stated in response to these amendments that he would not consider new limitations to the claims after final rejection. Instead, he stated that Manzo would

have to file a continuation application. Manzo subsequently filed a request for a File Wrapper Continuing Application (the "FWC request").

6) *The FWC request*

Manzo focused almost exclusively on the Steinmaier patent in his FWC request. He strenuously attempted to distinguish the Steinmaier patent from the processes claimed in the '943 patent based on the differential growth resulting from the doping of the gate electrode:

> There is absolutely no mention that oxidation growth in the Steinmaier patent is differential in nature. . . . [T]here is not even a clue in the Steinmaier patent that if the poly [gate electrode] layer were doped prior to the formation of the oxide layer 21, there would be an even thicker formation of oxide on the top and sides of the gate. . . . Applicants submit *that there is nothing whatsover in Steinmaier et al. alone which suggests that there is an advantage in doping the poly layer.* (emphasis in original)

Manzo further argued that combining the Steinmaier and Cohen patents still failed to teach the advantage of doping the gate electrode "to promote a high rate of oxidation."

Subsequent to the submission of the FWC request, the examiner interviewed Manzo to discuss claims 1, 6, and 15 in light of the Cohen and Steinmaier patents. The examiner stated the following in his "Examiner Interview Summary Record ("EISR"): "Mr. Manzo to submit preliminary amendment to place case in condition for allowance. Anisotropic etching limitation to be added to claims 1, [6, and 15]." At this point, independent claim 10 already had an anisotropic etching step. In response to the EISR, Manzo submited a voluntary amendment.

7) *The voluntary amendment*

As part of Manzo's voluntary amendment, he added an anisotropic etching step after the differential dielectric

growth step of claims 1, 6, and 15. He also removed some relevant language from each of the claims. In claim 1 Manzo removed "controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate." In claim 6 he replaced "heavily doped" with "doped" and "establishing a dielectric layer" with "growing a dielectric layer." Finally, in claim 15 he replaced "said gate being polysilicon doped to a sheet resistance of about 20 ohms per square" with "doped gate electrode."

Manzo explained that he amended the claims to include anisotropic etching to overcome a rejection based on a U.S. Patent No. 4,400,866 issued to Yeh *et al.* (the "Yeh patent"). Apparently, the examiner cited the Yeh patent "to show differential oxidation for providing a gap for a source/drain implant." Manzo did not explain why he removed the additional language from the claims. He merely stated that the independent claims include features of a doped gate and differential dielectric growth.

b. *Is TENA's claim differentiation argument valid?*

TENA now asserts that when the examiner issued his EISR requiring the additional limitation of an anisotropic etching step, he was indicating to Manzo that the patent claims did not require "substantial" differential growth as recited by claim 10. Therefore, TENA asserts that Manzo amended claims 1, 6, and 15 to provide for lesser levels of differential growth. For example, claim 1 only requires a "relatively thicker layer of oxide" over the gate electrode, and claims 6 and 15 require that the oxide layer is "relatively thick" over the gate electrode. However, Manzo left the language in claim 10 that requires doping of the gate electrode "to promote a high rate of differential thermal oxidation" resulting in a "substantially thicker" layer of oxide over the gate electrode. Based on these assertions, TENA argues that the doctrine of claim

differentiation prevents the court from construing claims 1, 6 and 15 to require prior doping to promote "substantial" differential dielectric growth.

As a threshold matter, TENA's argument contains a number of factual weaknesses. The EISR is ambiguous and does not support clearly TENA's assertion that the examiner did not think "substantial" differential growth was important to allowing the claims. To the contrary, the court could as easily interpret the EISR as supporting the notion that "substantial" differential growth was a necessary but insufficient condition for allowance. In addition, Manzo's removal of some language from the claims does not indicate clearly that doping was not important for differential growth. Manzo did not remove the word "doped" from the first step of claims 1, 6, and 15, nor did he remove the differential language from each of these claims. In particular, claims 6 and 15 still recite that "a high differenttial" of growth is required.

Even assuming that TENA's assertions regarding the EISR and Manzo's amendments are factually correct, however, TENA's claim differentiation argument suffers from two fundamental errors. The doctrine of claim differentiation prohibits construing one claim to include a limitation expressed in another claim if that construction renders one of the claims "superfluous." *Tandon Corporation v. United States International Trade Commission*, 831 F.2d 1017, 1023-24 (Fed.Cir.1987). The first error is that there are a number of differences between the independent claims beyond the level of differential growth that is required, such as the requirement of contact points, the use of dielectrics other than oxide, and so on. Thus, the court need not find a difference between the required levels of differential growth merely to prevent the claims from being "superfluous." *See id.*

Second, the court can construe the claims as providing for different levels of differential growth consistently with the notion that doping of the gate electrode must occur

first. Differential growth depends both on the amount of doping and on the ambient conditions during the growth stage. Lighter doping of the gate electrode might suffice for claim 1 because that claim does not require a "high differential" of dielectric growth as do claims 6 and 15. Furthermore, claim 15 requires steam oxidation, which will further increase the differential rate of growth over that which results from merely doping the gate electrode. In other words, Manzo's amendments affected how much doping or differential growth was required by each of the claims, not whether doping must precede dielectric growth. In fact, Manzo's removal of the "ambient conditions" language from claim 1, rather than implying that "substantial" differential growth is not important, more logically underscores the importance of doping alone to create sufficient differential growth to overcome the examiner's rejections over the Steinmaier patent and the Kamins article.

3. *What is the effect of adding the word "then" prior to the word "doped" in claims 1 and 15?*

TENA is correct that the word "then" was added to claims 1 and 15 before the word "doped." However, it is not at all clear that this fact alone would suggest that "then" does not apply to doping. As set out above, the plain language and sequential ordering of the claims in conjunction with the word "then" suggests that doping is required prior to differential dielectric growth. Moreover, when Manzo added the doping requirement in step (a) of each claim, he continually argued to the examiner that the doping was necessary to create sufficient differential growth to overcome the Steinmaier patent. At that point, the word "then" took on greater significance than requiring that the gate electrode be formed prior to the formation of the implant mask. The word "then" took on its natural meaning that each part of the preceding step had to be completed prior to the following step. This includes the requirement that the gate electrode be "doped" prior to differential dielectric growth.

4. *Do claims 16 and 17 prevent the court from construing claim 15 to require doping prior to differential growth?*

TENA argues that dependent claims 16 and 17 specifically allow for doping during the implantation of the source/drain regions. Thus, TENA argues that claims 16 and 17 recognize that doping need not occur prior to the differential growth step. TENA then argues that the court cannot construe claim 15, from which claims 16 and 17 depend, more narrowly than the required scope of claims 16 and 17. In other words, the court cannot construe claim 15 to require doping of the gate electrode prior to the differential thermal growth stage when claims 16 and 17 do not require this sequence.

Assuming for the sake of argument that TENA is correct in its assertion that claims 16 and 17 allow for doping during the implantation step, it does not follow necessarily that claims 16 and 17 recognize that doping need not occur prior to the differential growth step. An alternate reading of claims 16 and 17 suggests that the gate electrode can be doped prior to *and* after the differential growth stage. This reading is consistent with independent claim 15's requirement that doping must occur prior to differential growth. TENA argues, again under the banner of claim differentiation, that this reading would render claims 16 and 17 superfluous. However, Dr. Chung's declaration states that a second doping can produce improved electrical conductivity. Thus, reciting the possibility of a second doping after the differential dielectric growth step does not appear to render claims 16 and 17 "superfluous."

TENA's reading of claims 16 and 17 would require the court to remove the specific limitation in independent claim 15 that doping of the gate electrode must occur prior to differential thermal growth. The court cannot use a potentially broad reading of a dependent claim to ignore a specific limitation of the independent claim from which it depends, particularly when a logical alternative reading of the dependent claim exists.

5. *Does it matter if the prior art does not require doping of the gate electrode prior to differential dielectric growth?*

TENA argues that no prior art requires doping of the gate electrode prior to differential dielectric growth. Even if that were true, TENA cannot now eliminate a specific claim limitation that Manzo added to overcome a rejection by the PTO. *See Parks v. Fine*, 773 F.2d 1577, 1579 (Fed.Cir.1985) (stating that the insertion of a limitation to overcome an examiner's rejection is strong evidence of materiality); *Kinzenbaw v. Deere & Co.*, 741 F.2d 383, 389 (Fed.Cir.1984). Manzo ardently argued to the examiner that the Steinmaier patent did not teach doping the gate electrode to achieve differential growth. Moreover, Manzo never withdrew the word "doped" from step (a) of each of the claims even after he added the anisotropic etching step, and he never commented to the examiner that the sequential order of prior doping was no longer material to allowance of the claims. Given the plain meaning of the claim language, the teachings of the specification, and Manzo's arguments before the PTO, the court can only conclude that all of the claims of the '943 patent require doping of the gate electrode prior to the differential dielectric growth step.

E. *Do Intel's P652 and P852 (revs. 9 and 10) Processes Infringe the '943 Patent When Properly Construed?*

Having construed the relevant portions of the claims 1, 6, and 15, to require doping of the gate electrode prior to differentially growing a dielectric implant mask, the court must ascertain whether Intel's P652 and P852 (revs. 9 and 10) processes fail to follow this sequence and thus do not infringe the '943 patent. Intel asserts that these processes do not dope prior to a differential dielectric growth step. In response, TENA asserts that material facts are in dispute precluding summary judgment. However, TENA's "disputed material facts" consist of disputed

constructions of the patent terms and different interpretations of the effect of the prosecution history, which are insufficient to preclude summary judgment. *See Becton Dickinson and Co. v. C.R. Bard, Inc.*, 922 F.2d 792, 797 (Fed.Cir.1990).

TENA's expert Dr. Fair appears to admit in his declaration that Intel's P652 and P852 (revs. 9 and 10) processes do not dope the gate electrode prior to differentially growing a dielectric layer. TENA cites no other evidence in support of its argument that a genuine issue of material fact exists as to whether Intel dopes the gate electrode first. Thus, the court must conclude that no material facts are in dispute and that Intel is entitled to judgment as a matter of law that its P652 and P852 (revs. 9 and 10) do not infringe claims 1, 6, and 15 of the '943 patent.

TENA contends that even if the claims of the '943 patent require doping during step (a), there are "insubstantial differences between the claimed and accused products or processes." *Hilton Davis Chemical Co. v. Warner-Jenkinson Co.*, 62 F.3d 1512, 1521-22 (Fed.Cir.1995) (*en banc*). Thus, TENA argues that a question of fact exists as to whether Intel's processes infringe the claims of the '943 patent under the doctrine of equivalents. However, when an accused process does not perform a required step of the claimed process, there is no infringement either literally or under the doctrine of equivalents. *See London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1539, 1539 (Fed.Cir.1991). Intel's relevant processes do not form a "doped gate electrode" as the first step. Thus, these processes do not infringe under the doctrine of equivalents.

Prosecution history estoppel also bars TENA's doctrine of equivalents argument. Prosecution history estoppel prevents TENA from using the doctrine of equivalents to resurrect material previously surrendered during the prosecution of the '943 patent. *Texas Instruments*, 988 F.2d at 1173. Prosecution history estoppel is a question of law for the court. *Hoganas AB v. Dresser Industries, Inc.*,

9 F.3d 948, 952 (Fed.Cir.1993). Here, Manzo attempted to overcome multiple rejections based on the Steinmaier patent by emphasizing the importance of prior doping of the gate electrode to promote differential growth. Furthermore, he amended all of the claims to include doping in step (a) and differential growth in step (b). These actions by Manzo are sufficient to estop TENA from arguing now that the sequence of doping and then differentially growing a dielectric layer is not a material limitation of the claims of the '943 patent.

III. *CONCLUSION*

All of the claims of the '943 patent require doping of the gate electrode prior to differentially growing a dielectric layer over the MOS transistor. It is undisputed that Intel's P652 and P852 (revs. 9 and 10) do not dope the gate electrode prior to a differential dielectric growth step. Thus, Intel's processes do not infringe the '943 patent literally or under the doctrine of equivalents, and Intel is entitled to judgment as a matter of law.

The court will issue an Order in accordance with this Opinion.

APPENDIX C

UNITED STATES DISTRICT COURT
D. DELAWARE

Civil Action No. 95-199-RRM

THORN EMI NORTH AMERICA, INCORPORATED,
Plaintiff,

v.

INTEL CORPORATION,
Defendant.

Aug. 29, 1996

OPINION

McKELVIE, District Judge.

This is a patent case. Plaintiff Thorn EMI North America, Inc. ("TENA") is the owner of U.S. Patent No. 4,486,943 ("the '943 patent"). The '943 patent claims an improved method for fabricating metal oxide semiconductor field effect transistors ("MOS" or "MOSFET" transistors) in a large scale integrated circuit. On March 29, 1995, TENA filed a complaint against defendant Intel Corporation ("Intel") alleging that many of Intel's processes for manufacturing MOS transistors infringe the '943 patent. On June 19, 1995, Intel filed an answer denying infringement and asserting the invalidity of the '943 patent and certain equitable defenses.

On May 28, 1996, the court issued an opinion construing a portion of the claims of the '943 patent in accordance with *Markman v. Westview Instruments, Inc.*, 52 F.3d 967 (Fed.Cir.1995), *aff'd*, —— U.S. ——, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). *See Thorn EMI North America, Inc. v. Intel Corp.*, 928 F.Supp. 449 (D. Del.1996). Based on that construction, the court also granted Intel's motion for partial summary judgment of non-infringement with respect to three of its accused processes: P652, P852 (revisions 9 & 10), and P864.3. *Id.*

On June 10 and 11, 1996, immediately prior to trial, the court held a hearing to construe any remaining disputed claims. At the end of the hearing, the court orally announced its construction of the disputed claims. Upon hearing the court's claim constructon, Intel orally moved for summary judgment of noninfringement with respect to all of its remaining accused processes. The parties agreed to dismiss the jury pending resolution of Intel's motion. On June 19, 1996, TENA filed an answering brief in opposition to Intel's oral motion for summary judgment and a declaration by its expert Dr. Richard Fair in support of its opposition. On June 27, 1996, Intel filed a reply brief in support of its motion for summary judgment and a motion to strike portions of TENA's answering brief and all of Fair's June 19, 1996 declaration.

This is the court's explanation of its claim construction and its decision on Intel's motion to strike and motion for summary judgment.

I. *FACTUAL BACKGROUND*

In its May 28, 1996 Opinion, the court set out a description of the parties' contentions, the technology underlying this lawsuit, a brief description of the specification and the preferred embodiment of the '943 patent, and certain relevant aspects of the prosecution history. After the court issued its Opinion, TENA apparently withdrew its assertions of infringement with respect to independent

claims 6 and 15-17. TENA now asserts only independent claim 1 and dependent claims 2 and 3 against Intel's three remaining accused processes: P650, P651, and P852 (revisions 1-8).

Claim 1 states:

> 1. A method of fabricating on a substrate an MOS transistor having a gate electrode and a self-aligned source/drain region with zero overlap comprising:
>
> (a) forming a doped polysilicon gate electrode upon but insulated from the substrate; then
>
> (b) differentially thermally growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode whereby a relatively thicker layer of oxide is developed on the top and sides of the gate electrode and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate; then
>
> (c) anisotropically etching said oxide;
>
> (d) implanting a source/drain region in the substrate such that said implant mask shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a side edge of the implanted region; and then
>
> (e) heat driving the implanted source/drain region until its side edge is substantially aligned with the previously separated side edge of the gate electrode, whereby the source/drain edge is aligned with the gate electrode edge and there is substantially zero overlap.

The parties do not dispute any additional language in dependent claims 2 and 3.

During this litigation, the parties have presented the following issues of claim construction with respect to claim 1 of the '943 patent:

1) Must the gate electrode be doped prior to differentially thermally growing an oxide layer over the gate electrode?

2) How much oxide must be grown on the top and sides of the gate electrode versus on the substrate for the oxide to be "differentially" grown as required by step (b)?

3) What is the meaning of the word "gap" in step (d)?

4) What are the meanings of the phrases "substantially aligned" and "substantially zero overlap" in step (e)?

Prior to the hearing on June 10 and 11, 1996, both parties submitted briefs, expert reports, and documentary evidence outlining their positions with respect to these disputed issues. In its May 28, 1996 Opinion, the court decided the first issue in the affirmative. In other words, the court construed claim 1 to require doping the gate electrode prior to differentially thermally growing an oxide layer over the gate electrode.

At the conclusion of the hearing on June 10 and 11, the court announced its resolution of the remaining claim construction issues. The court construed the phrases "differentially thermally growing," "relatively thicker," and "relatively thinner" to require three elements:

1) the grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d);

2) the grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a "gap;" and

3) the top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness.

The court construed the term "gap" to mean the following:

> The area of the substrate under the oxide mask grown during step (b) that is protected by the mask from the implantation of ions that reverse the polarity of the substrate and thereby create the source and drain regions.

The court construed the phrases "substantially aligned" and "substantially zero overlap" to mean "the same as or very close to perfect alignment" and "the same as or very close to zero overlap."

On June 12, 1996, TENA read the following stipulated fact into the record ostensibly in order to place the case into a posture for the court to grant Intel's motion for summary judgment based on the court's claim construction:

> TENA and Intel stipulate that the thermally grown oxide layer on the top of the gate electrode in the P650, P651, and P852 (revs. 1-8) processes used by Intel to fabricate MOSFET transistors does not by itself mask the top of the gate electrode from the N+ and P+ implants at the energy levels used in said process for said implants.

The designation "N+" and "P+" refer to the polarity of the ions implanted into the gate electrode and the substrate during the fabrications of MOS transistors.

II. *DISCUSSION*

Intel's motion to strike seeks to eliminate all of Dr. Fair's June 19, 1996 declaration and portions of TENA's answering brief in opposition to Intel's motion for summary judgment, both of which are relevant to the court's

construction of the claims of the '943 patent and its decision on Intel's motion for summary judgment. Thus, the court must first determine whether to grant Intel's motion to strike. The court will then discuss its construction of the claims. Finally, the court will determine whether to grant Intel's motion for summary judgment.

A. *Should the Court Strike Dr. Fair's June 19, 1996 Declaration and Part of TENA's Answering Brief In Opposition to Intel's Motion for Summary Judgment?*

Intel makes three arguments in support of its motion to strike. First, Intel argues that TENA has introduced disputed facts by way of its answering brief after TENA's counsel represented that TENA would not do so. Second, Intel argues that TENA has introduced new contentions that were not disclosed during pre-trial discovery or in the Joint Pre-Trial Order. Third, Intel argues that Dr. Fair offers an opinion with respect to infringement under the doctrine of equivalents that was not in his expert report or identified during his deposition. TENA responds that its answering brief is a proper response to Intel's motion for summary judgment. In addition, TENA argues that the Joint Pre-trial Order and discovery gave Intel sufficient notice of TENA's allegedly new arguments and Dr. Fair's allegedly new opinion.

1. *Should the court allow TENA to introduce disputed facts?*

Even if TENA's counsel did in fact make a representation that TENA would not introduce disputed facts, the court will not hold TENA to that representation because to do so would be unfair in this instance. The Federal Circuit's recent decision in *Markman*, which requires the court to construe patent claims, poses new and unusual procedural dilemmas, particularly with respect to when the court should construe the claims. In this case, the court construed the claims after a hearing immediately

prior to the trial. Consequently, TENA's counsel had less than 24 hours in which to decide how to proceed with the case as a result of a claim construction largely adverse to TENA. TENA should not be penalized for this unusual procedural problem or its good faith attempt to spare the expense of a trial while protecting its rights.

Denying TENA the opportunity to present disputed facts in response to Intel's motion for summary judgment would also be inconsistent with the Federal Rules of Civil Procedure and the case law of the Court of Appeals for the Third Circuit. A party opposing a motion for summary judgment has the right and obligation to "set forth specific facts showing that there is a genuine issue for trial." Fed.R.Civ.P. 56(d); *see Brooks v. Hussman Corp.*, 878 F.2d 115 (3d Cir.1989) (reversing the trial court's decision to grant an oral motion for summary judgment without allowing the nonmoving party a reasonable opportunity to respond). Thus, the court will not grant Intel's motion to strike based on TENA's alleged representation that it would not present disputed facts.

2. *Should the court allow TENA to present its "new" contentions?*

The court requires parties to identify their factual and legal contentions in the Joint Pre-Trial Order. *See* Fed.R. Civ.Pro. 16(e); D.Del. LR 16.4(d). In addition, the court encourages parties to use "contention" interrogatories to seek the legal contentions made by opposing parties and the factual bases for those legal contentions. The purpose of contention interrogatories and the Joint Pre-Trial Order is to give each party sufficient notice of the opposing party's contentions at trial and an opportunity to respond to those contentions. The court will prevent a party from raising a claim or defense at trial that was not adequately described in a response to a contention interrogatory or in the Joint Pre-Trial Order. *See, e.g., CPC Int'l Inc. v. Archer Daniels Midland Co.*, 831 F.Supp.

1091, 1102-03 (D.Del.1993), *aff'd*, 31 F.3d 1176 (Fed. Cir.1994), *cert. denied*, —— U.S. ——, 115 S.Ct. 1176, 130 L.Ed.2d 1129 (1995); *Mars, Inc. v. Conlux USA Corp.*, 818 F.Supp. 707, 718 (D.Del.1993).

Intel identifies four allegedly new contentions made by TENA. TENA's first "new" contention is that even if claim 1 requires the side oxide thickness to be in a proportion of at least 1.77 to 1 to the substrate oxide thickness, claim 1 does not require the top oxide layer to be that thick. Intel is correct that TENA has never specifically stated an argument with respect to the top oxide layer in exactly this manner. TENA has maintained throughout this litigation, however, that neither the top nor the side oxide must be in any specific proportion to the substrate oxide. Moreover, it appears that Intel did not raise its contention that the top oxide ratio must be 1.77 to 1 until after the close of discovery. Therefore, TENA should be allowed to respond to Intel's contention in a manner that is consistent with its previous arguments.

TENA's second and related "new" contention is that Intel's processes do in fact result in a 1.77 to 1 ratio of top oxide thickness to substrate oxide thickness. Intel argues that TENA previously set a cap of 1.3 to 1 in its previous arguments and in Dr. Fair's previous opinions. As the court understands TENA's previous arguments, however, TENA merely cited 1.3 to 1 as a minimum ratio of growth as between an undoped polysilicon gate and a monosilicon substrate. Furthermore, TENA has identified additional factors that enhance oxide growth during Intel's processes, such as doping the gate electrode. Thus, TENA's "new" contention is merely a factual application of its contention that Intel's processes contain sufficient differential growth to infringe claim 1 of the '943 patent.

TENA's third "new" contention is that the Federal Circuit's decision in *Amhil Enterprises Ltd. v. Wawa, Inc.*, 81 F.3d 1554 (Fed.Cir.1996), is inapposite to the construction of the phrases "substantially zero overlap" and

"substantial alignment." Intel first raised this case in its claim construction brief. At the claim construction hearing, TENA indicated its contention that this case should not apply to the facts presented here. The court specifically gave TENA permission to elaborate its legal arguments in its answering brief in opposition to Intel's motion for summary judgment. Therefore, the court will not preclude TENA's arguments with respect to that case.

TENA's fourth "new" contention is that although Intel's grown oxide layer is not "thick enough on top of the gate electrode to serve as a mask for the implant of step (d)" as required by claim 1, the combination of the oxide layer and a deposited nitride layer used by Intel in its processes is thick enough to serve this function. Thus, TENA argues that there is a genuine issue of material fact with respect to infringement under the doctrine of equivalents that precludes the entry of summary judgment against TENA despite the stipulated fact. Intel argues that TENA did not make this doctrine of equivalents contention until after the court's claim construction. TENA argues that Intel had sufficient notice of this contention.

The court observes that TENA cannot satisfy its disclosure obligation merely by pointing to discovery responses in which it contended generically that Intel's processes infringe under the doctrine of equivalents. TENA's responses to Intel's interrogatories and the Joint Pre-Trial Order, however, specifically identify TENA's doctrine of equivalents contention. For example, TENA's response to Intel's Interrogatory No. 35 states that the term "implant mask" refers to a "growing an oxide so that the resulting thickness . . . subsequently serves in total or in combination with an additional masking layer as an ion implantation shield." In addition, the Joint Pre-Trial Order identifies the following issue of fact to be litigated:

> Whether . . . a thermally grown oxide layer over a gate electrode may be formed beneath a deposited

shielding layer to cooperate with the shielding layer in protecting the gate edges and the underlying substrate from ion implantation.

Therefore, the court will not preclude TENA from asserting its doctrine of equivalents contention.

3. *Should the court strike Dr. Fair's June 19, 1996 declaration?*

Intel claims that Dr. Fair never previously asserted an opinion with respect to the doctrine of equivalents arguments now advanced by TENA, that the combination of a grown oxide layer and a deposited nitride layer can serve as an implant mask or can satisfy the limitation requiring a certain amount of differential oxide growth. Dr. Fair's February 27, 1996 declaration, however, specifically refers to the use of a "composite mask" in Intel's processes consisting of nitride and oxide. Moreover, Intel's expert Dr. James Chung specifically denied that a composite nitride/oxide mask would satisfy the doctrine of equivalents, suggesting that Intel was on notice of TENA's contention.

Intel also claims that Dr. Fair previously stated that Intel's processes do not result in a ratio of greater than 1.3 to 1 of top oxide growth to substrate oxide growth. For the reasons set out above, the court finds that Intel is misreading Dr. Fair's previous statements. Dr. Fair was merely setting a lower limit of differential growth; he never set a cap on such growth. Therefore, the court will not strike any part of Dr. Fair's June 19, 1996 declaration.

B. *What is the Proper Construction of the Claims of the '943 Patent?*

The construction of patent claims is a matter for the court. *Markman,* 52 F.3d at 979-81. In construing the words and phrases in a claim, the court should give those words and phrases their ordinary meaning, unless the spe-

cification clearly indicates that the inventor intended a different meaning. *Intellicall, Inc. v. Phonometrics, Inc.*, 952 F.2d 1384, 1388 (Fed.Cir.1992). The court may also consider other words in the claim, other claims in the patent, the specification, and the prosecution history. *Markman*, 52 F.3d at 979-81; *Elf Atochem North America v. Libbey-Owens-Ford Co.*, 894 F.Supp. 844, 859 (D.Del.1995). The court may also consider relevant extrinsic evidence, such as expert testimony, when the patent, the specification, and the prosecution history are ambiguous. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed.Cir.1996).

1. *To what extent must the oxide growth of step (b) be "differential"?*

At the conclusion of the claim construction hearing on June 10 and 11, 1996, the court set out three requirements that are implied by the following phrases in step (b) of claim 1: "differentially thermally growing," "relatively thicker," and "relatively thinner." In its answering brief in opposition to Intel's motion for summary judgment, TENA raises arguments against each of these requirements. The court will first explain its basis for a particular construction of the claim language. It will then address TENA's arguments in opposition to that construction.

a. *"The grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d)"*

The plain language of claim 1 and the prosecution history support the requirement that the grown oxide must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d). Step (b) of claim 1 specifically recites "growing an oxide to serve as an implant mask having controlled thickness on both the top and sides of the gate electrode." Step (d) of claim 1 defines the term "implant mask" as a device that "shields an underlying portion of the substrate from implantation"

of the source and drain regions. Thus, the claim language states that a *grown oxide* mask *alone* must be sufficient to block implantation. Furthermore, the prosecuting attorney, Edward Manzo, added in his First Proposed Amendment after Final Rejection the limitation that the mask must consist of a grown oxide, rather than a deposited oxide or other deposited material.

TENA merely seeks to clarify this part of the court's construction in light of an alleged ambiguity. TENA believes that this construction might imply that the oxide layer must remain on top of the gate during the implant of step (d). Intel has never asserted this contention. In fact, Dr. Chung specifically testified at the claim construction hearing that the oxide layer may be removed after it is grown. Moreover, requiring the oxide layer to remain on top of the gate would be inconsistent with the anisotropic etching step in claim 1, which suggests that the oxide layer may be removed, and dependent claim 4, which explicitly requires the oxide layer to remain on top of the gate. Thus, to the extent the court's construction has caused any ambiguity, the construction is not meant to imply that the oxide layer must remain on top of the gate during implantation.

b. *"The grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a 'gap' "*

The requirement that the grown oxide must be thick enough on the side of the gate electrode to block the implant of step (d), thereby making a "gap" is also straightforward. According to step (d) of claim 1, the oxide mask "shields an underlying portion of the substrate from implantation to result in a gap between a side edge of the gate electrode and a side edge of the implanted region." Likewise, the specification, at column 3, lines 42-44, states that the oxide on the sides of the gate electrode must be thick enough to act as the implant mask of

step (d) "to shield underlying portions of the substrate from implantation." Thus, the oxide mask on the sides of the gate electrode must be thick enough *by itself* to block implantation of the source and drain regions.

TENA argues that "[i]f this construction means that the grown oxide alone must be thick enough to block the implant of step (d) thereby making a gap, it is erroneous for the reasons earlier discussed." TENA does not explicitly state the "earlier reasons" to which it is referring. It appears that TENA is arguing the following. The three requirements set out in the court's construction of the phrases "differentially thermally growing," "relatively thicker," and "relatively thinner" are interdependent. If the first requirement is that the oxide on the top of the gate electrode must remain on the top during the implant of step (d), that requirement is erroneous. Therefore, the requirement that the oxide mask on the sides of the gate electrode must be thick enough alone to block the implant of step (d) is erroneous.

TENA's argument is inapposite for two reasons. First, as set out above, the court has never construed claim 1 to require that the oxide mask remain on the top of the gate electrode during the implant of step (d). Second, the three requirements set out by the court are not interdependent in the way that TENA seeks to imply. Separate evidence from the claims, specification, and prosecution history supports each requirement independently. In finding each requirement, the court does not rely on a separate finding with respect to claim construction. For example, in finding that the oxide alone must be thick enough on the sides to block the implant of step (d), the court does not rely on its finding that the oxide on the top of the gate electrode must be thick enough to serve as an implant mask, or even its finding that doping the gate electrode must precede differential growth. These separate findings are consistent, but they do not interlock such that all fail if one is incorrect.

c. *"The top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness"*

The limitation that the top oxide thickness must be in a proportion of at least 1.77 to 1 to the substrate oxide thickness derives entirely from the prosecution history. As initially filed, claim 1 did not contain any reference to differential thermal growth. In subsequent amendments, however, Manzo added a differential growth limitation to dependent claims 2 and 3. The examiner nevertheless issues a final rejection of all of the claims as obvious in light of the combination of the Cohen and Steinmaier patents. Referring to the process of the Steinmaier patent, the examiner stated, among other things, that "[t]he thermally grown oxide is inherently thicker on the top and sides of the polysilicon gate than on the silicon substrate."

In his First Proposed Amendment After Final Rejection, Manzo amended claim 1 to state in relevant part:

. . . .

> (b) *differentially thermally growing* an implant mask of oxide of a controlled thickness on both the sides and on the top of the gate electrode *including controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate, whereby a relatively thicker layer of oxide is developed on the top and sides of the gate and a relatively thinner layer of oxide is developed on the intended source and drain regions of the substrate*; then. . . . (emphasis added to show amendments to claim)

Manzo observed, citing the Kamins article, that the inherent differential growth observable in Steinmaier would result in only a 7% to 9% differential. Manzo emphasized that the differential growth of the '943 patent contemplated, in its preferred embodiment, a differential of 300%. *See also* First Proposed Amendment at 14

("Clearly the application inherently supports the use in the claims of 'a high differential' because a ratio of 3 to 1 is certainly high compared to 1.07 to 1.").

In his subsequent File Wrapper Continuing Application, Manzo continued to distinguish the differential growth of the Steinmaier patent. Manzo stated:

> Further, the oxidation in a dry atmosphere at 950°C for a mere 50 minutes would not lead to an appreciably different thickness because, as Table I of Kamins establishes, the differential will be a factor of only 1.77, and that is when 375 minutes of dry oxidation occurs. . . . Thus, the offset which would result from the process specified in Steinmaier, even if the ordinarily skilled artisan inadvertently practiced the method with doped poly, would be quite small.

Thus, Manzo thought that a differential of "only 1.77" would result in an offset that is "quite small" compared the offset obtained by the differential growth required to practice the inventions of the '943 patent.

After the submission of the First Proposed Amendment and the File Wrapper Continuing Application, the examiner interviewed Manzo to discuss claim 1 in light of the Cohen and Steinmaier patents. The examiner stated the following in his "Examiner Interview Summary Record" ("EISR"): "Mr. Manzo to submit preliminary amendment to place case in condition for allowance. Anisotropic etching limitation to be added to claim[] 1. . . ."

Manzo subsequently submitted a Voluntary Amendment in which he added an anisotropic etching step to claim 1 and removed the following language from that claim: "controlling ambient conditions to promote a high rate of oxidation on the top and sides of the doped polysilicon gate compared to the silicon substrate." Manzo left in the requirement that the oxide be "differentially

thermally grown," however. In addition, he left in the requirement that the oxide on the top and sides of the gate electrode be "relatively thicker" than the oxide on the substrate, which is to be "relatively thinner." Therefore, it appears that differential growth is still important to claim 1 of the '943 patent and that a minimum differential of 77% is still required.

TENA makes three arguments in opposition to this limitation. First, TENA asserts that by removing the "ambient conditions" language, Manzo removed the limitation in claim 1 requiring a "high rate" of oxidation. Thus, TENA argues that the court's construction impermissibly resurrects that removed limitation. TENA is correct that Manzo removed the "high rate" limitation from claim 1. The court's construction requiring a 1.77 differential does not resurrect this limitation, however.

TENA fails to acknowledge that the "high differential" of claims 6, 10, and 15 is most likely the 300% differential identified in the specification, at column 3, lines 26-33, and in the First Proposed Amendment. Thus, while claim 1 may no longer require a 3 to 1 ratio, the removal of the "ambient conditions" language does not suggest what ratio is required. Moreover, Manzo did not remove *all* of the limitations directed to differential growth added in the First Proposed Amendment. Thus, TENA's argument only establishes that the differential required by claim 1 is less than 300%. A 77% differential is substantially smaller than the "high differential" of 300%. Therefore, the court is not resurrecting a limitation that was specifically removed from the claims. Rather, it is construing the claims consistently with Manzo's representations to the examiner.

TENA's second argument is that Manzo was not speaking about the oxide on the top of the gate electrode when he referred to the 1.77 differential. Instead, he was arguing that the 1.77 differential was an advantage for the side oxide in order to create a sufficient gap between the

edges of the source and drain regions and the edges of the gate electrode. TENA's argument appears correct but irrelevant. The patent does not teach, and none of the experts have explained, how one skilled in the art of making MOS transistors could achieve differential growth as between the top and sides of the gate electrode, which are made of the same material. Testimony at the hearing established that during the heating stage the oxide on the top of the gate electrode should grow at approximately the same rate as the oxide on the sides of the gate electrode. Therefore, a limitation that the oxide on the sides of the gate electrode must be 77% bigger than the oxide over the substrate as a practical matter is a limitation that the oxide on the top of the gate electrode must be 77% bigger as well.

TENA's third argument is that Manzo made a mistake in interpreting the Steinmaier patent in light of the Kamins article. Citing *In re Eskild,* 387 F.2d 987, 989 (C.C.P.A. 1968), TENA argues that the true content of Steinmaier and Kamins "must necessarily result from an inquiry made from the objective standpoint of . . . one of ordinary skill in the art." Manzo's statement does not appear to be properly characterized as a mistake, however. Rather, it appears that Manzo was defining the differential growth required to practice the patent by speaking in hypothetical terms about Steinmaier in light of Kamins. For example, the Steinmaier process involves oxidation of an undoped gate electrode in a dry atmosphere at 950°C for 50 minutes. Manzo's hypothetical, based on the Kamins article involved dry oxidation of a doped gate electrode for 375 minutes. Manzo obviously was aware that the Kamins article did not accurately reflect the process taught by Steinmaier ("Thus, the offset which would result from the process specified in Steinmaier, even if the ordinarily skilled artisan *inadvertently* practiced the method with doped poly, would be quite small." (emphasis added)). Manzo clearly had in mind that even if Steinmaier resulted

in 77% differential growth, such differential growth would not create a sufficient "gap" in order to practice the inventions of the '943 patent.

2. *What is the meaning of the word "gap"?*

At the close of the claim construction hearing, the court construed "gap" in the following manner:

> The area of the substrate under the oxide mask grown during step (b) that is protected by the mask from the implantation of ions that reverse the polarity of the substrate and thereby create the source and drain regions.

This construction resulted from a combination of the claim language and the expert testimony offered at the claim construction hearing. Step (d) of claim 1 states that the "gap" must exist "between a side edge of the gate electrode and a side edge of the implanted region." The "implanted region" of step (d) is the "source/drain region" of step (d) that is implanted after the oxide mask of step (b) is grown. Therefore, at a minimum, the claim language requires the oxide mask to protect the "gap" from implants that will constitute the source and drain regions. According to the testimony of both parties' experts, the source and drain regions are created by implanting ions that reverse the polarity of a portion of the substrate. Thus, the "gap" must be the area under the oxide mask that is protected by the mask from the implantation of ions that reverse the polarity of the substrate, thereby creating the source and drain regions.

The specification and the prosecution history both support this construction. The specification states:

> Because of the masking effect provided by the oxide on the sides of the gate electrode 16, the source/drain regions 20 and 22 are not implanted adjacent the vertical edges of the gate electrode. Rather, a gap is provided between the gate electrode 16 and

> the source/drain regions to allow for subsequent diffusion of the source/drain regions.

In other words, the oxide mask prevents the implantation next to the gate electrode of ions that would create the source and drain regions. Thus, the "gap" is the area of the substrate under the mask that is shielded from the implants that create those latter regions. Moreover, during the prosecution Manzo distinguished the Steinmaier patent, U.S. Patent No. 3,472,712, EPO publication 24 125, and EPO publication 34 508 because there was no "gap" between the sides of the gate electrode and the source and drain regions at the time of implantation. These prior art processes did not use a mask to prevent the implantation next to the gate of ions that would create the source and drain regions.

TENA objects to this construction of the word "gap." TENA argues that this construction expands the word "gap" beyond its ordinary usage, which merely implies a distance between two points. Moreover, TENA argues that this construction places limitations in the claims that are not supported by the evidence. Upon reflection, the court finds that TENA is partially correct and partially incorrect. TENA is correct that the word "gap" is not the proper source of these limitations. TENA is incorrect, however, because the claim language, the specification, the prosecution history, and the expert testimony all support these limitations. These limitations derive from reading step (d) of claim 1 as a whole, rather than just attempting to define the word "gap."

Step (d) of claim 1 states that the "gap" is "between a side edge of the gate electrode and a side edge of the implanted region." There is no dispute as to the location of the sides edges of the gate electrode. In addition, there appears to be no dispute as to the location of the "side edge of the implanted region." As set out above, the source and drain regions form the "implanted region."

Both parties' experts testified that the source and drain regions are regions of opposite polarity as compared to the substrate surrounding them. Thus, the side edge of a source or drain region is that area in the substrate where regions of opposite polarity meet; in other words, the side edge is where the concentration of N+ polarity equals the concentration of P+ polarity.

The logical conclusion is that the "gap" is simply the distance between the side edge of the gate electrode and the area in the substrate where the polarity reverses. Consequently, although the court's construction was correct when examining step (d) as a whole, the construction was slightly misleading in that it focused solely on the word "gap" in step (d) without also recognizing the implicit definition of the phrases "implanted region" and "a side edge of the implanted region."

In summary, the court will construe the word "gap" to have its ordinary meaning—"a distance between a side edge of the gate electrode and a side edge of the implanted region." The court will then construe the phrases "implanted region" and "source/drain region" to mean "regions of opposite polarity as compared to the substrate surrounding them." Finally, the court will construe the phrase "a side edge of the implanted region" to mean "where the concentration of N-type polarity equals the concentration of P-type polarity." This construction accurately captures the limitations of the claim as a whole while attaching each limitation to its corresponding claim language.

3. *What is the meaning of the phrases "substantially zero overlap" and "substantially aligned"?*

Throughout this litigation, Intel has asserted that "substantially zero overlap" and "substantially aligned" mean that the edges of the source/drain regions cannot overlap the edges of the gate electrode to any degree. By contrast, TENA has contended that "substantially zero overlap" and

"substantially aligned" do not require perfect alignment. Rather, TENA asserts that these phrases allows for a tolerance of ±10% of the gate electrode length. Neither argument has much credibility.

a. *Does the patent require zero overlap and perfect alignment?*

Intel essentially wants the court to read the word "substantially" out of the claims. Intel argues that the claims, the specification, and the prosecution history use the phrases "zero overlap/perfect alignment" and "substantially zero overlap/substantial alignment" interchangeably. For example, the title of the patent, and the abstract, the summary of the invention, and the preambles of claims 1, 10, and 15 recite "zero overlap," "perfect alignment," and "non-overlapping," whereas the preferred embodiment and step (e) of each claim recite phrases such as "closely aligned," "substantially aligned," "without substantial overlap," and "substantially zero overlap." Moreover, in Amendment B and the First Proposed Amendment, Manzo refers to "zero drain overlap devices" and "perfect alignment" in describing the inventions of the '943 patent.

Intel relies heavily on *Amhil Enterprises Ltd. v. Wawa, Inc.*, 81 F.3d 1554 (Fed.Cir.1996). In *Amhil*, the Court of Appeals for the Federal Circuit construed the phrases "substantially vertical sides," "substantially vertical side edges," and "substantially vertical side walls." The court observed that the preferred embodiment was completely vertical but stated that this was not determinative. *Id.* at 1559. Examining the entire specification, the court stated that the patentee used "substantially vertical" and "vertical" interchangeably, even within the claims themselves. *Id.* Examining the prosecution history, the court stated that the patentee narrowed "substantially" to overcome similar prior art and again used "substantially vertical" and "vertical" interchangeably. *Id.* at 1559-62. Finally,

the court stated that to avoid prior art in a crowded field, "substantially vertical face" had to be construed "as the same as or very close to 'vertical face.'" *Id.* at 1562.

Although *Amhil* is certainly helpful in construing the claims, it is not precisely on point. The invention in *Amhil,* which is related to plastic coffee mug lids, involves a large physical structure whose dimensions are relatively easy to control and measure. By contrast, the invention of claim 1 of the '943 patent is submicroscopic and has dimensions that are difficult to control and measure. In addition, the '943 patent does not use the terms "substantially aligned" and "aligned" or "substantially vertical" and "vertical" interchangeably within the claims themselves. Furthermore, the Federal Circuit seemed to rely primarily on the fact that the invention in *Amhil* was in a crowded art that compelled a narrow construction. Finally, the court still found that "substantially" had some meaning in the claim, albeit a very narrow meaning. Therefore, *Amhil* does not support Intel's effort to deprive "substantially" of any meaning whatsoever.

b. *Does the patent allow for a tolerance of ±10%?*

TENA wants to give the word "substantially" a broad, specific numerical reading. TENA points to the declaration and testimony of Dr. Fair, who defines "substantially zero overlap" and "substantially aligned" as allowing a tolerance as ±10% of the drawn gate length based on his "knowledge of MOS transistors." TENA also points to the specification, at column 1, lines 21-23, which uses the phrase "substantially aligned" in discussing the prior art: "Conventional fabrication techniques usually cause the edges of the source/drain regions to be initially substantially vertically aligned with the edges of their gate." Dr. Fair asserts that the alignment of these conventional fabrication techniques was within ±10% of the gate electrode length. Finally, TENA observes that one of Intel's ex-

perts, Dr. Frey, testified in a previous litigation that the term "substantially aligned" allowed for tolerances of ±10% of the gate electrode length.

TENA's evidence is less than convincing. It appears from Dr. Frey's previous testimony that he identified a range of ±5% on either side of the edge of the gate electrode, making a total range of 10% instead of ±10% for a total range of 20%. In addition, Dr. Chung testified, and Dr. Fair appeared to confirm, that an overlap of —10% would drastically reduce the performance of an MOS transistor, particularly with respect to the problem of Miller capacitance that the '943 patent seeks to avoid. Finally, Dr. Fair has not cited to anything in the claims or prosecution history in support of his opinion that the ±10% range is appropriate. His attempt to bootstrap his definition of "substantially" in the claims by defining the word "substantially" in the specification to mean the same thing is questionable without some objective basis.

c. *What does "substantially" mean?*

The word "substantially" tends to become somewhat of a chameleon when it appears in patent claims. It sneaks in during the prosecution of a patent application without having much substance or importance. The applicant rarely imposes strict mathematical requirements or guidelines for the word unless forced to do so by the examiner or by the prior art. After the issuance of the patent, however, the word swells up to envelop potentially infringing products or processes. The plaintiff's expert opines that a specific percentage range exists and, coincidentally, that the range encompasses the defendant's accused products or processes. Likewise, the defendant's expert opines that a smaller range exists that, coincidentally, does not encompass the defendant's accused products or processes.

Courts are in a bind when it comes to construing the word "substantially." On the one hand, the court has a duty according to *Markman* to construe the word to pro-

vide guidance to the jury as to the proper scope of the claim for determining infringement. This duty is particularly important when the parties' experts have testified to conflicting mathematical ranges required by the claim. Moreover, the ordinary meaning of the word "substantially"—"in a substantial manner" or "so as to be substantial" [1]—is practically useless as a guide to understanding or decision. On the other hand, a court should not impose mathematical centainty on a word when none exists. Often the claims, the specification, the prosecution history, and even all the extrinsic evidence will fail to provide any reasonable basis for selecting a mathematical range.

In the present case, the specification and the prosecution history present only theoretical limits to the percentage range allowed by the word "substantially." The specification states that the amount of overlap and alignment must be sufficient to prevent the occurrence of Miller capacitances in order to increase the speed of the transistor, but it does not provide mathematical reference. During the prosecution, Manzo specifically defined "substantially zero overlap" and "zero drain overlap" over the the results achieved by Figure 10 of U.S. Patent No. 4,356,623 issued to Hunter, Figure 4D of EPO publication 24 125, and the Steinmaier patent, but he never provided a mathematical explanation of the prior art process. Furthermore, the parties have never offered extrinsic evidence to suggest mathematical ranges based on these theoretical limits, and the court lacks sufficient understanding or skill to ascertain such ranges itself.

The parties instead have offered what appear to be litigation-driven constructions of the term "substantially" that have little support in the claim language, the specification, the prosecution history, or the extrinsic evidence. Intel's construction seeks to write the word out of the patent and to impose a level a mathematical certainty that does not appear physically possible. By contrast, TENA's

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[1] *Webster's Third New International Dictionary* 2280 (1986).

construction ignores a specific goal sought by the inventions of the '943 patent and argued by Manzo extensively during the prosecution history: manufacturing an MOS transistor with as little overlap as possible to improve operating speed and reduce Miller capacitances. Thus, at the end of the claim construction hearing, the court was compelled to reject both parties' constructions in favor of its own.

The court adopted the following construction of the word "substantially"—"the same as or very close to." In other words, "substantially zero overlap" means "the same as or very close to zero overlap" and "substantially aligned" means "the same or very close to perfect alignment." The court bases this construction on the many references to zero overlap and perfect alignment in the patent and the prosecution history and the stated importance in the specification of near-perfect alignment for the speed and efficiency of the inventions of the '943 patent. No further guidance is possible, however, because nearly every attempt to restate the word "substantially" adds little to its inherent meaning.

C. *Is Intel Entitled to Summary Judgment of Non-infringement With Respect to the Remainder of Its Accused Processes?*

Summary judgment is appropriate when the evidence admissible at trial fails to demonstrate a genuine issue of material fact and when the moving party is entitled to judgment as a matter of law. *See, e.g., Brewer v. Quaker State Oil Refining Corporation,* 72 F.3d 326, 329 (3d Cir.1995). In this case, Intel must show that TENA has presented insufficient evidence to carry its burden of persuasion at trial that Intel's processes infringe the '943 patent. *Id.* If Intel meets this burden, TENA must create a genuine issue of material fact such that a reasonable jury could return a verdict in its favor. *Id.* at 330 (citing *Anderson v. Liberty Lobby, Inc.,* 477 U.S. 242, 248, 106 S.Ct. 2505, 2510, 91 L.Ed.2d 202 (1986)).

To determine whether Intel is entitled to a judgment as a matter of law that its processes do not infringe the '943 patent, the court must perform a two-step process. The court first must construe the claims of the patent. *Texas Instruments, Inc. v. United States International Trade Commission*, 988 F.2d 1165, 1171 (Fed.Cir.1993). The court then must compare the properly construed claims of the patent to the accused processes to determine if all of the limitations in the claims are present in these accused processes. *Johnston v. IVAC Corporation*, 885 F.2d 1574, 1577 (Fed.Cir.1989). As set out above, the court has construed claim 1 of the '943 patent. Thus, the court must compare claim 1 with Intel's accused processes.

Based on the stipulated fact, TENA appears to agree that Intel's accused processes do not literally infringe claim 1 of the '943 patent. Because "the thermally grown oxide layer on the top of the gate electrode in the P650, P651, and P852 (revs. 1-8) processes used by Intel to fabricate MOSFET transistors does not by itself mask the top of the gate electrode from the N+ and P+ implants at the energy levels used in said process for said implants," Intel's accused processes do not meet the limitation that a grown oxide alone must be able to serve as an implant mask to prevent the implantation of the gate electrode.

TENA nevertheless argues that Intel's accused processes infringe claim 1 under the doctrine of equivalents. The doctrine of equivalents prevents an infringer from avoiding liability by making insubstantial changes to a patented product or process. *See Hilton Davis Chemical Co. v. Warner-Jenkinson Company, Inc.*, 62 F.3d 1512 (Fed.Cir.1995). A court can determine whether substantial differences exist by looking to whether the claimed and accused methods and products perform substantially the same function in substantially the same way to obtain the same result. *Id.* at 1517. Other evidence relevant to this inquiry may include whether one skilled in the art would have known of the interchangeability of an ingre-

dient, element, or step and would have considered the change insubstantial, whether the alleged infringer copied the claim in a way that may suggest insubstantial changes, whether the infringer attempted to design around the claims, and whether the alleged infringer developed its product or process through independent research. *Id.* at 1518-20.

TENA states that "Intel's accused processes all deposit a thick layer of nitride on top of a differentially thermally grown oxide layer, the combination of which is of sufficient thickness to block the implant of step (d)(if it remained on top of the gate during step (d))." Dr. Fair's June 19, 1996 declaration and other evidence offered by TENA demonstrate that all of Intel's accused processes deposit a nitride layer over a grown oxide layer. It seems that this combination could perform substantially the same function—blocking the implantation of the source and drain regions—in substantially the same way—by being sufficiently thick to shield the substrate—to achieve substantially the same result—a "gap" between the side edges of the gate electrode and the edges of the source and drain regions.

Intel does not appear to dispute that a nitride/oxide composite layer could serve as an implant mask for step (d) of claim 1 of the '943 patent. Intel nevertheless argues that the prosecution history estops TENA from making this argument. The doctrine of prosecution history estoppel prevents a patent owner from using the doctrine of equivalents to reclaim subject matter surrendered during the prosecution of the patent. *Loctite Corp. v. Ultraseal Ltd.*, 781 F.2d 861, 870 (Fed.Cir.1985). The standard is whether a person skilled in the art would reasonably conclude, upon reviewing the prosecution history, that the patent applicant gave up the equivalent structure to procure issuance of the patent. *Modine Mfg. Co. v. United States Int'l Trade Comm'n*, 75 F.3d 1545, 1555 (Fed. Cir.1996). Prosecution history estoppel may apply even

when the function/way/result test is met by the accused device. *Id.*

As initially filed, claim 1 in the patent application referred simply to "forming an implant mask of a controlled width on the sides of the gate electrode" during step (b) of the process. The patent examiner rejected this claim for reasons unrelated to the method of forming the mask. In his Amendment B, Manzo nevertheless amended many of the claims depending from claim 1 to include differential thermal growth as the specific method of forming the implant mask. Manzo also stated many advantages to using a grown oxide over a deposited oxide as the implant mask. Claim 1, however, still referred generically to "forming" the implant mask rather than "growing" it. The examiner subsequently rejected all of the claims based on the inherent differential oxide growth of the Steinmaier patent, even though claim 1 did not refer to differential growth.

In his First Proposed Amendment After Final Rejection, Manzo decided to focus on the alleged novelty of combining differential thermal oxide growth with anisotropic etching. He amended claim 1 to require differential thermal growth of an oxide implant mask. He also made many arguments distinguishing the inherent differential oxide growth of the Steinmaier patent. Manzo did not amend independent claim 6 to require growth of the implant mask, however. Claim 6 still referred generically to "establishing a dielectric layer" as the implant mask. The examiner eventually indicated that both claim 1 and claim 6 would be acceptable with the addition of an anisotropic etching step.

It was not until his subsequent Voluntary Amendment that Manzo amended claim 6 to require growth of the implant mask. Manzo stated the following in that document:

> Independent method claim [6] does not specifically recite oxidation but has been amended to include the feature of growing a dielectric layer to develop a high differential. Obviously, differential thermal oxidation is one method, but there might be other methods of establishing a dielectric with a differential growth process.

The court could read this statement in combination with Manzo's previous amendments as rejecting the use of any method other than growth to form the implant mask. It is not clear, however, that the court should find such an estoppel based on these facts.

It appears that Manzo voluntarily chose to pursue growth rather than deposition as the method of forming the implant mask. Moreover, he never indicated that deposition would not suffice to meet the limitations of the claims. For example, he never stated that deposition could not produce a sufficient differential between the portion of the mask on the gate electrode and the portion on the substrate. Finally, the examiner never rejected the use of deposition to form the implant mask; in fact, she appeared to accept deposition as an acceptable method by indicating that she would allow claim 6 without a growth limitation.

Based on these facts, the court cannot find that the prosecution history estops TENA from arguing that the combination of a differentially thermally grown layer and a deposited nitride layer infringes claim 1 under the doctrine of equivalents. Therefore, the court cannot grant Intel's motion for summary judgment on the issue of whether its remaining accused processes infringe the '943 patent under the doctrine of equivalents.

The court will issue an Order in accordance with this Opinion.

APPENDIX D

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

Civil Action No. 95-199-RRM

EMI GROUP NORTH AMERICA INC.,
Plaintiff,

v.

INTEL CORPORATION,
Defendant.

ORDER GRANTING INTEL CORPORATION'S MOTION FOR RECONSIDERATION AND GRANTING A SUMMARY JUDGMENT THAT EMI GROUP NORTH AMERICA INC. IS ESTOPPED FROM ALLEGING INFRINGEMENT UNDER THE DOCTRINE OF EQUIVALENTS

This is a patent case. EMI Group North America Inc., formerly Thorn EMI North America, Incorporated, is the owner of U.S. Patent No. 4,486,943 ("the '943 patent"). The '943 patent claims an improved method for fabricating metal oxide semiconductor field effect transistors ("MOS" or "MOSFET" transistors) in a large scale integrated circuit. EMI claims many of Intel Corporation's processes for manufacturing MOS transistors infringe the '943 patent.

On May 28, 1996, the court issued an opinion construing a portion of the claims of the '943 patent, and based on that construction entered an order granting Intel's motion for a partial summary judgment of noninfringement with respect to three of its accused processes. *See Thorn*

EMI North America, Inc. v. Intel Corp., 928 F. Supp. 449 (D. Del. 1996).

On June 11, 1996, following a hearing on claim construction, the court announced its construction of the balance of the claims in issue, including that the grown oxide of claim 1 must be thick enough on top of the gate electrode to serve as a mask for the implant of step (d). Following the hearing, the parties stipulated that the process used by Intel does not by itself mask the top of the gate electrode. Intel then moved for a summary judgment on EMI's infringement claims. EMI conceded that under the court's construction Intel would be entitled to a summary judgment it did not literally infringe the claims of the '943 patent. It argued, however, that Intel would still be liable for infringement under the doctrine of equivalents, because Intel's use of a composite of a layer of a nitride and oxide is the equivalent of the grown oxide of the implant mask for step (d) of claim one. Intel responded by arguing EMI should be barred by prosecution history estoppel from arguing Intel's composite is an infringing equivalent and renewed its motion for a summary judgment in its favor on EMI's infringement claims.

By an opinion dated August 29, 1996, the court explained its claim construction, confirmed Intel is entitled to a summary judgment on EMI's literal infringement claims, but rejected Intel's argument that EMI should be estopped from claiming Intel's composite mask infringes under the doctrine of equivalents. *See Thorn EMI North America, Inc. v. Intel Corp.*, C.A. No. 95-199-RRM (D. Del. August 29, 1996).

Intel has moved for a clarification of the August 29, 1996 opinion. The parties have completed briefing and presented argument on the motion. For the reasons set out below, the court will grant the relief sought by Intel.

In its August 29, 1996 Opinion, the court reviewed the file history of the '943 patent, and noted that while Manzo, the prosecuting attorney, had amended claim 1 to

require differential thermal growth of an oxide implant, he had not initially amended independent claim 6 to require growth of the implant mask. In his subsequent Voluntary Amendment, Manzo noted in offering an amendment to claim 6, "differential thermal oxidation is one method, but there might be other methods of establishing a dielectric with a differential growth process." The court noted that with this statement in the Voluntary Amendment, it did not appear Manzo had abandoned a claim based on deposition as a method of forming the implant mask. Consequently, the court declined to find that the prosecution history estopped EMI from arguing that the combination of a differentially thermally grown oxide layer and a deposited nitride infringes claim 1 under the doctrine of equivalents. *Thorn EMI North America, Inc. v. Intel Corp.*, C.A. No. 95-199-RRM, slip op. at 32-33 (D. Del. August 29, 1996).

In its motion for a clarification, Intel argues the prosecution history shows that when Manzo was faced with prior art that caused him to cancel the broad claim to "forming" a dielectric, he not only restricted the claims to "differentially thermally growing an oxide . . .," but also cancelled claims in which the mask was formed by a composite layer. For example, in the initial application, Manzo had reported that the preferred embodiment of the invention employed differential dielectric growth. He included figures 1 through 4 as illustrative of that preferred embodiment. Manzo included claims based on what he described as alternative techniques that would not require differential dielectric growth. He included figures 6, 7 and 8 to illustrate these alternative techniques. Claim 8 was directed to a combination or composite mask. It claimed:

> 8. A method as set forth in claim 1 wherein the step of forming an implant mask includes:
>
> forming a first dielectric on the top of the gate electrode;

forming a second dielectric over the first dielectric, over the sides of the gate electrode, and over the intended source/drain region; and

etching the second dielectric where it overlies the intended drain/source region, whereby the second dielectric formed on the sides of the gate electrode comprises the implant mask and the source/drain regions may be implanted at the etched portion of the second dielectric.

Later, Manzo added a second claim, claim 23, that was directed to a combination or composite mask.

23. A method for fabricating a self-aligned semiconductor device having a gate, source, and drain with zero overlap compiling:

patterning a dielectric in a layer overlying a layer of gate material and forming a gate over a substrate with a substantially coterminous first dielectric over said gate, said dielectric having a controlled thickness; then

establishing a second dielectric having a controlled second thickness, covering the top and sides of said first dielectric, the sides of said gate, and the substrate regions which will subsequently become the source and drain, whereby the thickness of dielectric on the top of said gate exceeds the thickness of dielectric on said source and drain regions; then

applying source and drain implants to the substrate using said second dielectric as an implant mask, whereby the implants will be laterally separated from side edges of said gate by said second thickness; and

heat driving said implants laterally until their side edges are aligned with said side edges of said gate, whereby there is substantially zero overlap; and

retaining said dielectrics on the top and sides of said gate.

After the Patent Office rejected all pending claims in light of Hunter, Cohen, Steinmaier and Stoffel, Manzo filed his First Proposed Amendment after Final Rejection, in which he cancelled certain claims, including claims 8 and 23, and sought to distinguish the invention over the prior art. He wrote in part,

> . . . [A]pplicant considers that the rejections of claims on the basis of Steinmaier or Stoffel in combination with Cohen are infirm because these references do not suggest the use of differential thermal growth with a high differential rate to form a device according to claim 1. Further, none of the prior art suggests combining such differential thermal growth with anisotropic etching for this purpose. Third, none of the prior art is seen to suggest the combination of such differential thermal growth with such anisotropic etching combined with the self-alignment of contacts.

Intel contends the court erred in suggesting that Manzo voluntarily chose to pursue growth rather than deposition as a method of forming an implant mask. It contends Manzo's First Proposed Amendment is evidence that with the prior art crowding in, Manzo was forced to make a choice. He chose one path in further prosecution of the claims—differentially thermally grown oxide for the implant mask. Hunter taught forming an implant mask of a deposited dielectric layer on the top and sides of the gate electrode. Steinmaier taught thermally growing an oxide which was inherently thicker over the top and sides of the gate electrode than on the substrate. Stoffel taught an implant mask having a differential that was caused by a deposited oxide on top of the gate electrode and a grown oxide on the sides of the gate and over the substrate. Manzo found his path by cancelling all claims directed to the composite implant masks and by amending claim 1 to require differential thermal growth of an oxide to serve as the implant mask.

After having considered these matters, the court agrees it should consider certain comments and conclusions in its August 29, 1996 opinion. Manzo's cancelling claims 8 and 23 in the context of his arguments as to how the invention could be distinguished over the prior art suggests he felt compelled to abandon claims to a composite implant mask. Having abandoned those claims in light of the prior art, EMI is estopped from claiming under the doctrine of equivalents that the '943 claims cover composite masks, including the combinaton of a grown layer and a deposited nitride layer. *See Townsend Eng'g Co. v. HiTec Co., Ltd.*, 829 F.2d 1086, 1091 (Fed. Cir. 1987) (finding that patentee who adds limitations during prosecution to avoid prior art is barred from asserting broad, original claims).

For these reasons,

IT IS HEREBY ORDERED Intel's motion for a summary judgment on EMI's claims of infringement under the doctrine of equivalents is granted, and the clerk shall enter judgment in favor of Intel and against EMI on the claims in EMI's complaint.

/s/ [Illegible]
United States District Judge

Dated: October 31, 1996

APPENDIX E

[Filed Nov. 30, 1998]

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

Nos. 97-1137, 97-1153

EMI GROUP NORTH AMERICA, INC.,
Plaintiff-Appellant,

v.

INTEL CORPORATION,
Defendant/Cross-Appellant.

ORDER

A combined petition for rehearing and suggestion for rehearing in banc having been filed by the APPELLANT, and a response thereto having been invited by the court and filed by the CROSS-APPELLANT, and the petition for rehearing having been referred to the panel that heard the appeal, and thereafter the suggestion for rehearing in banc and response having been referred to the circuit judges who are in regular active service,

UPON CONSIDERATION THEREOF, it is

ORDERED that the petition for rehearing be, and the same hereby is, DENIED and it is further

ORDERED that the suggestion for rehearing in banc be, and the same hereby is, DECLINED.

The mandate of the court will issue on December 7, 1998.

Circuit Judge CLEVENGER and Circuit Judge SCHALL did not participate in the vote.

FOR THE COURT

/s/ Jan Horbaly
JAN HORBALY
Clerk

Dated: November 30, 1998